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Part - II

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CHAPTER 01
Nutrition

1. Which of the following best defines the biological process of nutrition?
(A) The excretion of metabolic waste from the body
(B) The process of obtaining and utilizing food for energy, growth, and repair
(C) The transport of oxygen from the lungs to the tissues
(D) The release of energy from glucose in the mitochondria

2. What is the defining characteristic of autotrophic nutrition?
(A) Organisms consume complex organic matter prepared by others
(B) Organisms break down dead and decaying organic matter
(C) Organisms obtain nutrients by living inside the body of a host
(D) Organisms synthesize their own organic food from simple inorganic substances using an energy source

3. In which mode of nutrition does an organism secrete digestive enzymes onto dead organic matter and absorb the digested nutrients?
(A) Saprophytic nutrition
(B) Holozoic nutrition
(C) Parasitic nutrition
(D) Autotrophic nutrition

4. What are the primary end products of photosynthesis?
(A) Carbon dioxide and water
(B) Lactic acid and energy
(C) Glucose and oxygen
(D) Starch and carbon dioxide

5. Which of the following factors is not strictly essential for the process of photosynthesis?
(A) Oxygen
(B) Carbon dioxide
(C) Sunlight
(D) Chlorophyll

6. How does Amoeba primarily engulf its food?
(A) Through a specialized mouth-like pore called a cytostome
(B) By using tiny hair-like structural projections called cilia
(C) By absorbing dissolved nutrients across the cell membrane
(D) By forming temporary extensions called pseudopodia

7. Which of the following represents a type of parasitic nutrition?
(A) A mushroom growing on a decaying fallen log
(B) Cuscuta growing on a living host plant
(C) An Amoeba consuming a unicellular Paramecium
(D) A herbivorous cow grazing on green grass

8. In the human digestive system, where does the digestion of carbohydrates begin?
(A) Stomach
(B) Small intestine
(C) Buccal cavity
(D) Oesophagus

9. What is the specific function of the enzyme salivary amylase?
(A) Breakdown of complex dietary proteins into amino acids
(B) Emulsification of large dietary fat globules in lipid digestion
(C) Conversion of excess blood glucose into glycogen reserves
(D) Breakdown of complex starch into simpler sugars

10. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R).
Assertion (A): The inner lining of the human stomach is protected from its own acid by a layer of mucus.
Reason (R): Hydrochloric acid is necessary in the stomach to create an acidic medium for the action of pepsin.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.

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(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

11. Which organ in the human body produces bile juice?
(A) Gall bladder
(B) Liver
(C) Pancreas
(D) Stomach

12. What is the primary role of the finger-like projections called villi in the small intestine?
(A) To secrete digestive enzymes required for protein breakdown
(B) To increase surface area for absorbing digested food
(C) To propel undigested food materials into the large intestine
(D) To store hepatic bile juice temporarily before it is released

13. What is the main function of the large intestine in humans?
(A) Absorption of water from undigested food
(B) Complete digestion of fats
(C) Absorption of nutrients like amino acids and glucose
(D) Secretion of intestinal juice

14. Which enzyme is responsible for the breakdown of emulsified fats in the small intestine?
(A) Trypsin
(B) Pepsin
(C) Lipase
(D) Amylase

15. Which of the following is the correct sequence of organs in the human alimentary canal?
(A) Mouth, Stomach, Oesophagus, Small Intestine, Large Intestine
(B) Mouth, Oesophagus, Stomach, Large Intestine, Small Intestine
(C) Mouth, Stomach, Small Intestine, Oesophagus, Large Intestine
(D) Mouth, Oesophagus, Stomach, Small Intestine, Large Intestine

16. What defines a balanced diet?
(A) A diet containing exclusively high-protein food items intended for muscle growth
(B) A diet consisting solely of uncooked raw fruits, leafy green vegetables, and seeds
(C) A diet containing balanced amounts of all essential nutrients
(D) A diet providing maximum calorie intake regardless of specific nutrient types

17. The deficiency of Vitamin A in the human diet primarily leads to which disease?
(A) Scurvy disease
(B) Night blindness
(C) Rickets in bones
(D) Infantile beriberi

18. Which essential mineral salt is critical for the synthesis of thyroxine hormone, the deficiency of which causes goitre?
(A) Iron
(B) Calcium
(C) Sodium
(D) Iodine

19. Kwashiorkor is a disease primarily caused by the severe deficiency of which nutrient in the diet?
(A) Proteins
(B) Carbohydrates
(C) Fats
(D) Minerals

20. Which of the following structural adaptations is common in herbivorous animals?
(A) A relatively short small intestine specialized to quickly digest meat products
(B) Sharp, elongated and pointed canine teeth adapted for tearing tough flesh
(C) A long small intestine for digesting cellulose
(D) The complete structural absence of a stomach chamber within the body

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21. What is the primary purpose of the process of "chewing the cud" in ruminants?
(A) To break down partially digested plant material
(B) To regulate internal body temperature through oral evaporation
(C) To excrete excess metabolic water produced from the mouth glands
(D) To synthesize toxic defense substances that deter potential predators

22. Match the items in List I with those in List II.
List I: (Enzyme)
P. Pepsin
Q. Amylase
R. Lipase
S. Trypsin
List II: (Function)
1. Digests starch in the mouth

2. Digests proteins in the stomach
3. Digests proteins in the small intestine
4. Digests fats in the small intestine

(A) P-2, Q-1, R-4, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-3, Q-1, R-4, S-2
(D) P-2, Q-4, R-1, S-3

23. Through which structures does most of the gaseous exchange required for photosynthesis occur in leaves?
(A) Lenticels
(B) Stomata
(C) Cuticle
(D) Epidermis

24. Which cell organelle is the actual site of photosynthesis in a plant cell?
(A) Mitochondrion
(B) Ribosome
(C) Chloroplast
(D) Nucleus

25. The energy released from food during respiration is primarily used by organisms to synthesize which molecule?
(A) DNA
(B) RNA
(C) Chlorophyll
(D) ATP

26. Which of the following is the best example of a symbiotic relationship related to nutrition?
(A) Rhizobium bacteria in leguminous root nodules
(B) A carnivorous tiger hunting a wild deer in the forest
(C) An external parasitic tick feeding on a domestic dog
(D) Saprophytic bread mould growing on a moist slice of bread

27. Which of the following statements about lichens is correct?
(A) They are completely parasitic organisms growing on forest trees
(B) They are a symbiotic algal-fungal association
(C) They are purely autotrophic non-flowering higher plants
(D) They derive nutrients entirely through saprophytic nutrition

28. Arrange the steps of holozoic nutrition in Amoeba in the correct sequence.
I. Digestion
II. Ingestion
III. Egestion
IV. Assimilation
V. Absorption

(A) II, I, V, IV, III
(B) I, II, V, IV, III
(C) II, I, IV, V, III
(D) V, I, II, IV, III

29. Which dietary component is essential for preventing the deficiency disease known as scurvy?
(A) Vitamin C
(B) Vitamin D
(C) Vitamin K
(D) Vitamin B_{12}

30. Which mineral is predominantly required for the formation of strong bones and teeth in humans?
(A) Iron mineral
(B) Essential iodine
(C) Calcium
(D) Zinc element

31. Identify the odd one out based on the mode of nutrition.
(A) Cuscuta
(B) Tapeworm
(C) Plasmodium
(D) Mango tree

32. Which of the following statements regarding photosynthesis is incorrect?
(A) Oxygen is released as a byproduct
(B) Light energy is converted into chemical energy
(C) Carbon dioxide is oxidized to form glucose
(D) Chlorophyll absorbs light energy

33. The continuous contraction and relaxation of the walls of the food pipe to push food downward is known as:
(A) Locomotion
(B) Peristalsis
(C) Emulsification
(D) Assimilation

34. What is the end product of the complete digestion of proteins in the human body?
(A) Fatty acids
(B) Glycerol
(C) Glucose
(D) Amino acids

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35. Consider the following statements about gastric juice in humans:
I. It contains hydrochloric acid which makes the medium acidic.
II. It contains the enzyme pepsin which breaks down fats.
III. It contains mucus which protects the stomach lining.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

36. Which secretion creates an alkaline medium in the small intestine for the action of pancreatic enzymes?
(A) Gastric juice
(B) Saliva
(C) Bile juice
(D) Intestinal mucus

37. Which term describes the mode of nutrition where an organism takes in complex solid food material?
(A) Holozoic
(B) Saprotrophic
(C) Parasitic
(D) Symbiotic

38. The disease rickets is caused by a deficiency of which vitamin?
(A) Vitamin A
(B) Vitamin B
(C) Vitamin C
(D) Vitamin D

39. What is the function of the guard cells in a leaf?
(A) They transport water directly to the inner mesophyll cells
(B) They control the opening and closing of stomata
(C) They protect the leaf lamina against herbivorous grazing animals
(D) They synthesize structural components of the primary cell wall

40. Marasmus is a nutritional disorder commonly seen in infants. It is caused by the simultaneous deficiency of which two components?
(A) Essential vitamins and dietary minerals
(B) Micronutrients iron and calcium
(C) Proteins and calories
(D) Lipids, fats and organic vitamins

41. Which of the following organisms is an omnivore?
(A) Lion
(B) Cow
(C) Elephant
(D) Crow

42. In an ecosystem, which organisms represent the first level of any food chain based on their nutrition?
(A) Autotrophs
(B) Saprophytes
(C) Herbivores
(D) Carnivores

43. Which of the following best describes the process of emulsification in digestion?
(A) The breakdown of dietary starch into maltose by salivary secretions
(B) The splitting of fat globules into smaller drops by bile
(C) The absorption of water from undigested food in the large intestine
(D) The conversion and storage of excess glucose as glycogen in the liver

44. What is the role of the enzyme trypsin in pancreatic juice?
(A) It digests starch into sugar
(B) It digests proteins into peptides
(C) It digests emulsified fats
(D) It absorbs digested food into the blood

45. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R).
Assertion (A): The small intestine in human beings is highly coiled and has millions of villi.
Reason (R): This highly coiled structure and the presence of villi reduce the rate of food absorption.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

46. Which part of the ruminant stomach is considered the "true stomach" where gastric juices are secreted?
(A) Rumen
(B) Reticulum
(C) Abomasum
(D) Omasum

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47. Plants primarily absorb essential mineral salts such as nitrates and phosphates through their:
(A) Leaves
(B) Stems
(C) Flowers
(D) Roots

48. During photosynthesis, the splitting of water molecules is directly caused by:
(A) Atmospheric heat energy
(B) The continuous presence of dissolved carbon dioxide
(C) Absorbed solar light energy
(D) The physical action of stomatal guard cells

49. Which of the following is not a part of the human large intestine?
(A) Caecum segment
(B) Duodenum
(C) Colon section
(D) Rectum segment

50. Consider the following events related to photosynthesis:
I. Absorption of light energy by chlorophyll.
II. Conversion of light energy to chemical energy.
III. Splitting of water molecules into hydrogen and oxygen.
IV. Reduction of carbon dioxide to carbohydrates.
Which of the above statement(s) is/are correct?
(A) I, II and IV only
(B) I, III and IV only
(C) II, III and IV only
(D) I, II, III and IV

51. The process by which digested food is taken up into body cells and used for energy, growth, and repair is called:
(A) Assimilation
(B) Food digestion
(C) Nutrient absorption
(D) Waste egestion

52. Which deficiency disease is characterized by pale skin, fatigue, and reduced oxygen-carrying capacity in the blood?
(A) Goitre
(B) Scurvy
(C) Rickets
(D) Anaemia

53. The basic unit of energy used to measure the energy value of food is the:
(A) Joule unit
(B) Calorie
(C) Watt power
(D) Newton unit

54. Anaemia is primarily caused by a deficiency of which mineral?
(A) Sodium
(B) Potassium
(C) Iron
(D) Iodine

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55. Which of the following components of food does not provide energy but is essential for preventing constipation?
(A) Dietary fibre
(B) Saturated and unsaturated fats
(C) Complex and simple carbohydrates
(D) Dietary protein sources

56. What happens to the stomata when the guard cells swell by taking up water?
(A) The stomatal pore closes completely
(B) The stomatal pore opens
(C) The guard cells burst
(D) The leaf sheds from the plant

57. Which type of tooth is primarily responsible for tearing food in carnivorous animals?
(A) Incisors
(B) Premolars
(C) Molars
(D) Canines

58. The process of converting complex, insoluble food materials into simple, soluble absorbable forms is the definition of:
(A) Respiration
(B) Excretion
(C) Digestion
(D) Circulation

59. Which of the following is a completely saprophytic organism?
(A) Pitcher plant
(B) Tapeworm
(C) Venus flytrap
(D) Yeast

60. How does the liver contribute to the digestive process despite not producing any digestive enzymes?
(A) By producing and releasing insulin for glucose absorption
(B) By secreting bile to emulsify fats
(C) By absorbing excess water from the

remaining digested food
(D) By physically churning and crushing incoming food particles

61. Identify the incorrect statement regarding heterotrophic nutrition.
(A) Heterotrophs use sunlight to make glucose.
(B) All non-photosynthetic animals and fungi are heterotrophs.
(C) Parasitic species represent a specialized type of heterotroph.
(D) Holozoic organisms ingest complex solid organic matter particles.

62. Which part of the leaf serves as the primary site for gaseous exchange?
(A) Midrib
(B) Veins
(C) Petiole
(D) Stomata

63. Which vitamin is known to be synthesized in the human skin in the presence of sunlight?
(A) Vitamin A
(B) Vitamin D
(C) Vitamin B
(D) Vitamin C

64. What is the role of intestinal juice (succus entericus) in the digestive system?
(A) It initiates the digestion of dietary starch inside the mouth.
(B) It destroys harmful incoming bacteria entering with consumed food.
(C) It completes digestion of all major nutrients.
(D) It maintains an acidic medium required inside the stomach.

65. The temporary storage organ for feces before it is eliminated from the body is the:
(A) Colon
(B) Caecum
(C) Anus
(D) Rectum

66. In plants, the transport of soluble products of photosynthesis is known as:
(A) Translocation
(B) Transpiration
(C) Evaporation
(D) Respiration

67. Match the items in List I with those in List II.
List I: (Vitamin)
P. Vitamin A
Q. Vitamin B_1
R. Vitamin C
S. Vitamin D
List II: (Deficiency Disease)
1. Beriberi
2. Scurvy
3. Night blindness
4. Rickets
(A) P-3, Q-1, R-2, S-4
(B) P-1, Q-2, R-3, S-4
(C) P-3, Q-2, R-1, S-4
(D) P-4, Q-1, R-2, S-3

68. The chemical substance present in the chloroplasts that captures solar energy is:
(A) Carotene
(B) Chlorophyll
(C) Xanthophyll
(D) Anthocyanin

69. Which pair correctly identifies an organism and its specific mode of nutrition?
(A) Amoeba - Saprophytic organism
(B) Cuscuta - Autotrophic plant
(C) Mushroom - Holozoic organism
(D) Plasmodium - Parasite

70. What is the biological term for the removal of undigested and unabsorbed food materials from the body?
(A) Egestion
(B) Ingestion
(C) Digestion
(D) Assimilation

71. The end products of fat digestion are:
(A) Essential amino acid chains
(B) Simple sugars glucose and fructose
(C) Short peptides and peptone chains
(D) Fatty acids and glycerol

72. Which portion of the small intestine directly receives bile and pancreatic juice?
(A) Jejunum section
(B) Duodenum
(C) Ileum region
(D) Caecum segment

73. Which of the following is a water-soluble vitamin?
(A) Vitamin A
(B) Vitamin C
(C) Vitamin D
(D) Vitamin K

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74. Rhizobium bacteria reside in the root nodules of leguminous plants. What benefit do they provide to the plant?
(A) They produce dietary glucose through active photosynthesis.
(B) They protect sensitive plant roots against harmful fungal infections.
(C) They fix nitrogen into usable forms for plants.
(D) They increase water absorption rates by breaking down soil rocks.

75. Which statement accurately describes the relationship between nutrition and respiration?
(A) Respiration directly synthesizes food which is subsequently utilized in nutrition.
(B) Both metabolic processes take place exclusively within autotrophic organisms.
(C) Nutrition involves taking in oxygen gas, while respiration releases oxygen.
(D) Nutrition supplies glucose oxidized in respiration for energy.

76. Consider the following statements about Amoeba:
I. It is a unicellular organism.
II. It possesses a specialized digestive tract.
III. Digestion occurs inside a food vacuole.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

77. Which of the following describes a holozoic mode of nutrition?
(A) Absorbing nutrients from a living host without killing it immediately
(B) Ingesting complex organic matter and digesting it internally
(C) Secreting enzymes outside the body to break down dead matter
(D) Synthesizing organic food from inorganic molecules

78. In the human stomach, which enzyme is secreted in an inactive form to protect the stomach wall, and later activated by HCl?
(A) Pepsinogen
(B) Trypsinogen
(C) Amylase
(D) Lipase

79. Which of the following elements is a macronutrient required by plants for proper growth?
(A) Zinc
(B) Copper
(C) Manganese
(D) Nitrogen

80. The primary energy source for almost all food chains on Earth is:
(A) Geothermal energy
(B) Chemical energy from soil
(C) Solar energy
(D) Wind energy

81. Which animal possesses a multi-chambered stomach to facilitate the digestion of cellulose?
(A) Human
(B) Cow
(C) Dog
(D) Lion

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82. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R).
Assertion (A): Herbivores have a longer small intestine compared to carnivores.
Reason (R): Meat is easier to digest than plant materials containing cellulose.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

83. The muscular tube that connects the mouth to the stomach is known as the:
(A) Trachea pipe
(B) Larynx cavity
(C) Oesophagus
(D) Pharynx region

84. Which carbohydrate cannot be digested by humans due to the lack of a specific enzyme?
(A) Plant starch
(B) Liver glycogen
(C) Table sucrose
(D) Cellulose

85. The sphincter muscle that regulates the exit of food from the stomach into the small intestine is the:
(A) Cardiac sphincter
(B) Anal sphincter
(C) Ileocaecal valve

(D) Pyloric sphincter

86. Which of the following sets represents entirely fat-soluble vitamins?
(A) Vitamins A, D, E, and K
(B) Vitamin B complex and Vitamin C
(C) Vitamins A, B, and C
(D) Vitamins B_1, B_2, B_6, and B_{12}

87. A person showing signs of swollen and bleeding gums, and delayed wound healing is likely deficient in:
(A) Calcium
(B) Vitamin C
(C) Vitamin A
(D) Iodine

88. Choose the correct sequence of steps involved in the breakdown of food in human digestion.
(A) Emulsification of fats → Action of salivary amylase → Action of pepsin
(B) Action of pepsin → Emulsification of fats → Action of salivary amylase
(C) Action of salivary amylase → Action of pepsin → Emulsification of fats
(D) Action of salivary amylase → Emulsification of fats → Action of pepsin

89. Which structural feature of a leaf provides a large surface area for maximum light absorption?
(A) Network of veins
(B) Leaf petiole stalk
(C) Central leaf midrib
(D) Leaf lamina

90. In photosynthesis, oxygen is released as a byproduct. From which molecule does this oxygen originate?
(A) Water
(B) Carbon dioxide
(C) Glucose
(D) Chlorophyll

91. The primary organ for the absorption of digested nutrients in the human body is the:
(A) Stomach
(B) Large intestine
(C) Small intestine
(D) Liver

92. Identify the incorrect pairing of a digestive organ and its secretion.
(A) Salivary glands - Oral saliva
(B) Liver - Hepatic bile juice
(C) Pancreas - Pancreatic juice
(D) Gall bladder - Acid

93. What is the role of magnesium in plant nutrition?
(A) It forms the center of chlorophyll molecules.
(B) It forms the main rigid structural framework of cell walls.
(C) It is directly responsible for the upward transport of water.
(D) It prevents wilting and loss of turgidity in plant tissues.

94. Consider the following statements about the pancreas:
I. It acts as both an endocrine and an exocrine gland.
II. It secretes insulin to regulate blood sugar.
III. It releases trypsin and lipase into the small intestine.
IV. It produces bile juice to digest fats.
Which of the above statement(s) is/are correct?
(A) I, II and III only
(B) II, III and IV only
(C) I, III and IV only
(D) I, II, III and IV

95. The swelling of the thyroid gland in the neck region is a classic symptom of:
(A) Scurvy
(B) Marasmus
(C) Rickets
(D) Goitre

96. Which component of gastric juice kills harmful bacteria that may enter the stomach with food?
(A) Proteolytic enzyme pepsin
(B) Gastric protective mucus
(C) Hydrochloric acid
(D) Milk-curdling enzyme renin

97. The term "omnivorous" refers to an animal that feeds on:
(A) Both plants and animals
(B) Only plant parts
(C) Only the flesh of other animals
(D) Dead and decaying matter

98. Which of the following is not a requirement for calculating the daily calorie requirement of an individual?
(A) Age
(B) Physical activity level
(C) Body weight
(D) Blood type

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99. The energy requirement of the human body is lowest during which state?
(A) Heavy physical labor
(B) Digestion of a heavy meal
(C) Sleep
(D) Walking

100. In an experiment to test for the presence of starch in a leaf, which chemical is used?
(A) Benedict's solution
(B) Copper sulphate
(C) Iodine solution
(D) Sodium hydroxide

101. Arrange the following layers of a typical dicot leaf in order from top surface to bottom surface.
I. Lower epidermis
II. Upper epidermis
III. Spongy mesophyll
IV. Palisade mesophyll
(A) II, IV, III, I
(B) II, III, IV, I
(C) I, III, IV, II
(D) IV, II, I, III

102. Which part of the ruminant digestive system is responsible for storing the swallowed food quickly while grazing?
(A) Reticulum
(B) Rumen
(C) Omasum
(D) Abomasum

103. The absorption of minerals by plant roots from the soil is primarily an active process because:
(A) Minerals naturally and continuously flow outward from plant roots
(B) Soil mineral concentration is lower than in root cells
(C) Plant roots completely lack cell walls required for passive transport
(D) Soil mineral particles are physically too large to pass through tissues

104. Which of the following organisms relies entirely on a parasitic mode of nutrition?
(A) Pitcher plant
(B) Bread mould
(C) Tapeworm
(D) Amoeba

105. Match the items in List I with those in List II.
List I: (Term)
P. Autotroph
Q. Heterotroph
R. Saprophyte
S. Parasite
List II: (Description)
1. Derives nutrition from dead organic matter
2. Synthesizes its own food
3. Derives nutrition from a living host
4. Cannot synthesize its own food
(A) P-2, Q-4, R-1, S-3
(B) P-4, Q-2, R-1, S-3
(C) P-2, Q-4, R-3, S-1
(D) P-1, Q-3, R-2, S-4

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106. In the context of a balanced diet, which nutrient group provides the maximum energy per gram?
(A) Carbohydrates
(B) Proteins
(C) Fats
(D) Vitamins

107. Which of the following prevents the entry of food into the windpipe during swallowing?
(A) Epiglottis
(B) Glottis opening
(C) Larynx structure
(D) Pharynx passage

108. The main structural component of plant cell walls, which serves as a dietary fiber in humans, is:
(A) Plant starch
(B) Cellulose
(C) Animal glycogen
(D) Fungal chitin

109. What is the condition caused by a severe deficiency of proteins and calories in children, characterized by a shriveled appearance and loss of muscle mass?
(A) Kwashiorkor
(B) Scurvy
(C) Beriberi
(D) Marasmus

110. The process by which Amoeba expels undigested waste from its body is known as:
(A) Cellular ingestion
(B) Nutrient assimilation
(C) Egestion
(D) Phagocytic ingestion

111. Which fluid transports absorbed fats away from the small intestine?
(A) Blood in capillaries
(B) Lymph in lacteals
(C) Bile in bile ducts

(D) Saliva in salivary ducts

112. During daytime, what is the net gaseous exchange taking place in the stomata of a typical green leaf?
(A) Intake of oxygen, release of carbon dioxide
(B) Intake of carbon dioxide, release of oxygen
(C) Intake of nitrogen, release of oxygen
(D) Release of both oxygen and carbon dioxide

113. The pigment that gives green leaves their color is located in which part of the chloroplast?
(A) Thylakoids
(B) Chloroplast stroma
(C) Outer organelle membrane
(D) Inner organelle membrane

114. Which form of carbohydrate is stored in human muscles and the liver as a reserve energy source?
(A) Starch
(B) Cellulose
(C) Glycogen
(D) Maltose

115. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R).
Assertion (A): Bile juice contains no digestive enzymes but plays a critical role in digestion.
Reason (R): Bile creates an acidic medium in the intestine and breaks down proteins.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

116. A patient is advised to eat citrus fruits like oranges and lemons. The doctor is likely trying to treat or prevent which condition?
(A) Night blindness
(B) Scurvy
(C) Goitre
(D) Rickets

117. Which of the following is considered an inorganic substance used by autotrophs to make food?
(A) Carbon dioxide
(B) Simple glucose sugar
(C) Organic amino acid molecule
(D) Long-chain fatty acid

118. Which statement is true regarding the role of roughage in the human diet?
(A) It is digested efficiently to supply high amounts of metabolic energy.
(B) It contains all essential amino acids required for protein synthesis.
(C) It adds bulk and promotes smooth bowel movements.
(D) It actively assists in the synthesis and formation of red blood cells.

119. The mode of nutrition in a mushroom is best classified as:
(A) Fully autotrophic
(B) Parasitic nutrition
(C) Holozoic nutrition
(D) Saprotrophic

120. During human digestion, which of the following is NOT absorbed directly into the blood capillaries of the villi?
(A) Amino acids
(B) Glucose
(C) Fatty acids
(D) Water

121. Consider the following statements about digestion in humans:
I. Digestion of carbohydrates is completely finished in the stomach.
II. The large intestine does not secrete any digestive enzymes.
III. Saliva contains an enzyme that acts on starch.
Which of the above statement(s) is/are incorrect?
(A) I only
(B) II only
(C) III only
(D) I and II only

122. Which part of the human tooth is the hardest substance in the body and helps in chewing food?
(A) Dentine
(B) Pulp
(C) Enamel
(D) Cementum

123. The function of the enzyme 'lipase' is most similar to which household agent in its physical effect?
(A) Detergent breaking up grease
(B) Strong acid completely dissolving a metal surface
(C) Synthetic glue firmly binding two solid surfaces
(D) Porous sponge rapidly soaking up spilled

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water

124. Which plant nutrient is absorbed primarily as nitrates and nitrites from the soil?
(A) Carbon
(B) Oxygen
(C) Nitrogen
(D) Hydrogen

125. The symbiotic association between fungi and the roots of higher plants, which helps in mineral absorption, is called:
(A) Lichen association
(B) Mycorrhiza
(C) Rhizobium bacteria
(D) Cuscuta parasite

126. Which component of the human diet is the primary building block for tissue growth and repair?
(A) Carbohydrates
(B) Proteins
(C) Fats
(D) Vitamins

127. If an individual has a removed gall bladder, they might face difficulty in digesting which nutrient?
(A) Complex carbohydrates
(B) Dietary fats
(C) Proteins
(D) Water-soluble vitamins

128. What is the function of the waxy cuticle on the upper surface of a leaf?
(A) To efficiently absorb sunlight required for plant photosynthesis
(B) To facilitate the continuous atmospheric entry of carbon dioxide
(C) To reduce water loss through transpiration
(D) To release excess metabolic oxygen gas into the surrounding atmosphere

129. What happens to the rate of photosynthesis if the plant is kept in total darkness?
(A) It increases
(B) It remains the same
(C) It stops entirely
(D) It shifts to producing proteins instead of glucose

130. A child is observed to have a pot-belly, thin limbs, and poor brain development. These are classic symptoms of:
(A) Rickets
(B) Marasmus
(C) Kwashiorkor
(D) Night blindness

131. Which of the following best describes 'assimilation' in humans?
(A) Using absorbed nutrients to build cell tissues
(B) Breaking down large food particles into smaller soluble molecules
(C) Passing digested food substances directly into the bloodstream
(D) Removing undigested solid metabolic wastes from the human body

132. Consider the following characteristics of a dietary component:
I. Yields roughly 4 kilocalories per gram.
II. Is the body's primary and most immediate source of energy.
III. Includes sugars and starches.
IV. Is completely digested into amino acids.
Which of the above statement(s) is/are correct regarding carbohydrates?
(A) I, II and III
(B) II, III and IV
(C) I, III and IV
(D) I, II, III and IV

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133. Which of the following pairs is correctly matched regarding the end products of digestion?
(A) Dietary proteins → Fatty acids
(B) Complex starch → Amino acids
(C) Fats → Fatty acids
(D) Disaccharide maltose → Peptides

134. Which of the following organisms does NOT possess a specialized digestive system?
(A) Human body
(B) Bovine cow
(C) Amoeba
(D) Aquatic fish

135. The process of obtaining energy by oxidizing food inside the cells is known as:
(A) Plant photosynthesis
(B) Nutrient digestion
(C) Respiration
(D) Waste excretion

136. Iodine is necessary for the proper functioning of which human gland?
(A) Pancreas
(B) Pituitary
(C) Thyroid
(D) Adrenal

137. Which type of teeth are completely absent in adult humans?
(A) Incisors
(B) Canines
(C) Premolars
(D) None of the above; all are present

138. Which structure carries bile from the liver to the gall bladder and small intestine?
(A) Pancreatic duct
(B) Bile duct
(C) Lymphatic vessel
(D) Oesophagus

139. How many chambers are present in the stomach of a typical ruminant like a cow?
(A) One
(B) Two
(C) Three
(D) Four

140. Match the items in List I with those in List II.
List I: (Digestive Organ)
P. Stomach
Q. Small Intestine
R. Large Intestine
S. Liver
List II: (Primary Function)
1. Secretes bile juice
2. Churns food and secretes pepsin
3. Absorbs water from waste
4. Main site of nutrient absorption
(A) P-2, Q-4, R-3, S-1
(B) P-1, Q-3, R-4, S-2
(C) P-4, Q-2, R-1, S-3
(D) P-2, Q-3, R-4, S-1

141. The condition in which bones become soft and bend easily in children due to Vitamin D deficiency is:
(A) Scurvy
(B) Rickets
(C) Goitre
(D) Anaemia

142. A person relying entirely on a diet of polished white rice is highly susceptible to which deficiency disease?
(A) Scurvy
(B) Beriberi
(C) Rickets
(D) Night blindness

143. Which gas is utilized by green plants during the process of photosynthesis?
(A) Carbon dioxide
(B) Free oxygen gas
(C) Atmospheric nitrogen
(D) Pure methane gas

144. Which process demonstrates the interdependence of autotrophs and heterotrophs?
(A) Evaporation and water condensation
(B) Photosynthesis and respiration
(C) Nutrient digestion and waste excretion
(D) Animal locomotion and reproduction

145. The vestigial organ attached to the human large intestine is the:
(A) Appendix
(B) Storage gall bladder
(C) Lymphatic spleen
(D) Endocrine pancreas

146. Which nutrient is required in trace amounts but is absolutely essential for regulating bodily functions?
(A) Carbohydrates
(B) Water
(C) Vitamins
(D) Fats

147. A diet lacking in iron over a long period will most likely result in:
(A) Significantly reduced production of hormone thyroxine
(B) Structural weakening of protective tooth enamel
(C) Impaired and poor blood clotting mechanism
(D) Decreased blood hemoglobin levels

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148. Select the correct order of the distinct processes involved in animal nutrition.
(A) Digestion, Ingestion, Absorption, Assimilation, Egestion
(B) Ingestion, Digestion, Assimilation, Absorption, Egestion
(C) Ingestion, Digestion, Absorption, Assimilation, Egestion
(D) Absorption, Ingestion, Digestion, Assimilation, Egestion

149. Why do plants need magnesium?
(A) For the synthesis of chlorophyll
(B) For the digestion of proteins
(C) For opening stomata during the night
(D) For breaking down glucose

150. Which part of the Amoeba acts comparably to the human stomach by holding and digesting food?
(A) Nucleus
(B) Pseudopodium
(C) Food vacuole
(D) Contractile vacuole

151. Which of the following is NOT a form of heterotrophic nutrition?
(A) Saprophytic nutrition
(B) Parasitic nutrition
(C) Phototrophic
(D) Holozoic nutrition

152. Which enzyme requires an acidic medium to function optimally?
(A) Salivary amylase
(B) Pepsin
(C) Trypsin
(D) Pancreatic lipase

153. A plant with variegated leaves (green and non-green parts) is kept in sunlight. Upon starch testing with iodine, which part will turn blue-black?
(A) Only the green part
(B) The entire leaf
(C) Only the non-green part
(D) None of the leaf

154. What is the primary reason that foods rich in fats provide more long-term energy than carbohydrates?
(A) They are digested and absorbed significantly faster by the alimentary canal.
(B) They contain a much higher ratio of oxygen atoms per individual molecule.
(C) They yield twice as many calories per gram as carbohydrates.
(D) They pass directly into the blood capillaries without undergoing digestion.

155. Consider the following statements about parasitic nutrition:
I. The parasite generally benefits at the expense of the host.
II. Ectoparasites live on the outer surface of the host.
III. The parasite always kills the host immediately.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

156. The term "Calorie" used in daily nutritional requirements generally refers to:
(A) Standard gram calories
(B) Kilocalories
(C) Absolute joules
(D) System megajoules

157. Which plant is renowned for exhibiting a carnivorous mode of nutrition to supplement its nitrogen requirement?
(A) Medicinal neem tree
(B) Pitcher plant
(C) Tropical banyan tree
(D) Evergreen mango tree

158. What is the function of the rumen in ruminant animals?
(A) To continuously absorb maximum quantities of water from food
(B) To store and ferment chewed food with bacteria
(C) To secrete strong acidic digestive juices into the stomach chamber
(D) To eject undigested solid waste materials out of the body

159. Identify the incorrect statement concerning a balanced diet.
(A) It must include sufficient water and roughage.
(B) The exact composition varies with a person's age and occupation.
(C) It eliminates fats entirely to prevent obesity.
(D) It prevents malnutrition and deficiency diseases.

160. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R).
Assertion (A): Saliva in the mouth initiates the digestion of proteins.
Reason (R): Salivary amylase breaks down complex proteins into amino acids.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

161. The deficiency of which vitamin results in poor blood clotting after a cut or wound?
(A) Vitamin A

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(B) Vitamin K
(C) Vitamin E
(D) Vitamin C

162. Which cells surround the stomatal pore and control its size?
(A) Epidermal cells
(B) Mesophyll cells
(C) Guard cells
(D) Xylem vessels

163. In a typical food chain, an animal that eats only plants is designated as a:
(A) Primary consumer
(B) Secondary consumer
(C) Tertiary consumer
(D) Producer

164. The structure that prevents the backflow of food from the stomach to the oesophagus is the:
(A) Pyloric sphincter
(B) Cardiac sphincter
(C) Uvula
(D) Epiglottis

165. The complete digestion of carbohydrates, proteins, and fats is finalized in which part of the human alimentary canal?
(A) Stomach
(B) Liver
(C) Small Intestine
(D) Large Intestine

166. Which organic substance makes up the majority of the dry mass of a plant, produced primarily via photosynthesis?
(A) Structural proteins
(B) Complex lipids
(C) Carbohydrates
(D) Essential minerals

167. Which of the following describes the relationship in lichens?
(A) A parasitic organism living continuously inside a host tree
(B) A symbiotic algal-fungal association
(C) Two distinct plants actively competing for the same sunlight
(D) A standard carnivorous predator-prey relationship in nature

168. The "cud" that ruminants chew is best described as:
(A) Fully digested food substances returned from the lower intestines
(B) Regurgitated, partially digested plant matter
(C) A solid metabolic waste product ready for immediate egestion
(D) Unchewed fresh green leaves stored within the cheek pouches

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169. What is the role of potassium in plant nutrition?
(A) It forms the fundamental chemical structural basis of cellular DNA.
(B) It regulates stomatal opening and closing.
(C) It acts as the central coordinating metal atom of chlorophyll.
(D) It directly fixes atmospheric nitrogen into usable plant nitrates.

170. Which of the following organs is NOT considered an accessory digestive gland?
(A) Liver
(B) Pancreas
(C) Salivary Gland
(D) Spleen

171. If an Amoeba is placed in a sterile environment devoid of any food particles, which process will immediately halt?
(A) Cellular respiration
(B) Ingestion
(C) Metabolic excretion
(D) Water osmosis

172. The rhythmic wave-like contractions of the alimentary canal are called:
(A) Dialysis process
(B) Peristalsis
(C) Cardiac systole
(D) Cardiac diastole

173. Consider the following statements regarding vitamins:
I. They do not yield energy.
II. They are required in large quantities daily.
III. They protect the body against diseases.
IV. Vitamin C is easily destroyed by excessive cooking.
Which of the above statement(s) is/are correct?
(A) I, II and III
(B) II, III and IV
(C) I, III and IV
(D) I, II, III and IV

174. Which of the following is considered an energy-yielding nutrient?
(A) Vitamin C
(B) Iron
(C) Carbohydrates

(D) Dietary fibre

175. The internal lining of the small intestine features numerous transverse folds and villi. The primary evolutionary advantage of this is:
(A) Efficiently trapping foreign pathogenic bacteria in the lumen
(B) Maximizing surface area for absorption
(C) Continuously releasing large amounts of protective mucus
(D) Temporarily storing undigested food materials

176. Which condition is caused by a diet providing sufficient calories but deficient in protein?
(A) Infantile marasmus
(B) Kwashiorkor
(C) Scurvy disease
(D) Severe anaemia

177. Arrange the following levels of organization regarding a plant's photosynthetic machinery in order from smallest to largest.
I. Chlorophyll molecule
II. Chloroplast
III. Mesophyll cell
IV. Leaf
(A) I, II, III, IV
(B) II, I, III, IV
(C) IV, III, II, I
(D) I, III, II, IV

178. What happens to the rate of photosynthesis when the carbon dioxide concentration is slightly increased under optimal light conditions?
(A) It decreases rapidly and continuously.
(B) It increases to a limit.
(C) It halts and stops completely.
(D) It remains permanently unchanged.

179. A person complaining of weakness, brittle bones, and frequent fractures might be deficient in:
(A) Vitamin A and Iron
(B) Vitamin D and Calcium
(C) Vitamin C and Iodine
(D) Vitamin B complex and Sodium

180. The process by which plants release water vapour through stomata is called:
(A) Respiration
(B) Transpiration
(C) Translocation
(D) Guttation

181. In human digestion, the breakdown of food into simple, soluble molecules is a type of:
(A) Exclusively physical reaction only
(B) Exclusively chemical reaction only
(C) Both physical and chemical
(D) Atomic or nuclear reaction

182. Which part of the digestive tract absorbs the maximum amount of water from the undigested food?
(A) Oesophagus
(B) Stomach
(C) Small intestine
(D) Large intestine

183. Identify the odd one out based on the digestive enzymes.
(A) Pepsin
(B) Trypsin
(C) Amylase
(D) Peptidase

184. The function of bile salts in digestion is most closely related to:
(A) Significantly decreasing the overall pH of incoming food
(B) Increasing surface area of fat droplets
(C) Directly digesting starches into soluble simple sugars
(D) Chemically coagulating liquid milk proteins in gastric juice

185. Match the items in List I with those in List II.
List I: (Organism)
P. Herbivore
Q. Carnivore
R. Omnivore
S. Saprophyte
List II: (Food Source/Mode)
1. Dead leaves and rotting wood
2. Only plants
3. Only animals
4. Both plants and animals
(A) P-2, Q-3, R-4, S-1
(B) P-3, Q-2, R-1, S-4
(C) P-4, Q-1, R-2, S-3
(D) P-2, Q-4, R-3, S-1

186. Which vitamin is necessary to prevent the disease Beriberi?
(A) Retinol (Vitamin A)
(B) Vitamin B_1
(C) Ascorbic acid (Vitamin C)
(D) Calciferol (Vitamin D)

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187. In a human being, the sequence of teeth from the front to the back of the jaw is:
(A) Premolars, Molars, Canines, Incisors
(B) Incisors, Canines, Premolars, Molars
(C) Canines, Incisors, Molars, Premolars
(D) Molars, Premolars, Canines, Incisors

188. Which nutritional category does bread mould (Rhizopus) belong to?
(A) Autotrophic organism
(B) Parasitic organism
(C) Saprophyte
(D) Symbiotic organism

189. During the process of photosynthesis, which energy conversion takes place?
(A) Chemical energy to light energy
(B) Heat energy to mechanical energy
(C) Light energy to chemical energy
(D) Light energy to heat energy

190. Why is iodine applied to a leaf after boiling it in alcohol during a photosynthesis experiment?
(A) To test for the presence of glucose
(B) To test for the presence of starch
(C) To test for the presence of proteins
(D) To stop the process of photosynthesis

191. Which component of food does not require digestion before it is absorbed into the bloodstream?
(A) Carbohydrates
(B) Water
(C) Fats
(D) Proteins

192. Consider the following statements regarding the role of water in the human body:
I. It acts as a solvent for biochemical reactions.
II. It yields high amounts of energy when oxidized.
III. It helps in regulating body temperature.
Which of the above statement(s) is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

193. The microscopic hair-like structures present on the cells lining the small intestine villi, which further increase surface area, are called:
(A) Cilia
(B) Microvilli
(C) Flagella
(D) Pseudopodia

194. Which of the following elements is critical for the synthesis of proteins in plants?
(A) Sodium
(B) Nitrogen
(C) Chlorine
(D) Iodine

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195. Which disease is characterized by bow legs, pigeon chest, and weak bones in children?
(A) Rickets
(B) Scurvy
(C) Marasmus
(D) Kwashiorkor

196. The process of taking food into the body is officially termed as:
(A) Ingestion
(B) Egestion
(C) Digestion
(D) Secretion

197. Which of the following is true about symbiotic nutrition?
(A) Both participating organisms benefit.
(B) One participating organism benefits while the other host is harmed.
(C) Both participating organisms are significantly harmed.
(D) Neither participating organism is positively or negatively affected.

198. Consider the following statements about a balanced diet:
I. It improves immunity and body resistance.
II. It requires expensive and exotic foods to be truly balanced.
III. It supplies the necessary amount of energy for daily activities.
IV. It provides materials for tissue repair and growth.
Which of the above statement(s) is/are correct?
(A) I, II and III
(B) I, III and IV
(C) II, III and IV
(D) I, II, III and IV

199. What is the main source of nitrogen for carnivorous plants like the Venus flytrap?
(A) Soil nitrates
(B) Digested insects
(C) Atmospheric nitrogen gas
(D) Symbiotic bacteria

200. In heterotrophic nutrition, why do organisms depend on autotrophs directly or indirectly?

(A) Heterotrophs cannot synthesize organic food from inorganic carbon.
(B) Heterotrophs lack internal mitochondria required to produce cellular energy.
(C) Heterotrophs do not require environmental water for basic cellular survival.
(D) Heterotrophs can only successfully survive in environments of complete darkness.

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ANSWERS

1. (B) The process of obtaining and utilizing food for energy, growth, and repair
Nutrition is a fundamental biological process wherein living organisms acquire nutrients from external food sources and assimilate them for various physiological functions. These functions include metabolic energy production, structural tissue growth, cellular repair, and overall body maintenance. Through this process, essential organic and inorganic compounds are processed to sustain life functions effectively.

2. (D) Organisms synthesize their own organic food from simple inorganic substances using an energy source
Autotrophic nutrition is a mode of nutrition where organisms create complex organic nutrients from basic inorganic raw materials like carbon dioxide and water. Photosynthetic autotrophs use radiant light energy, while chemosynthetic autotrophs utilize chemical oxidation energy. This capacity to produce bio-molecules internally distinguishes autotrophs from heterotrophic organisms that rely on external organic sources.

3. (A) Saprophytic nutrition
Saprophytic nutrition involves extracellular digestion where organisms secrete specialized enzymes directly onto non-living, decaying plant or animal organic matter. These secreted enzymes break down complex organic polymers into simpler soluble molecules outside the body. Subsequently, the saprophytic organism absorbs these nutrient products across its cell membrane to fuel its metabolic activities and cellular maintenance.

4. (C) Glucose and oxygen
Photosynthesis is a chemical process taking place in green plants where carbon dioxide and water react in the presence of sunlight and chlorophyll. The main biochemical products generated are glucose, which acts as a primary energy source, and oxygen gas, which is released as a metabolic byproduct vital for aerobic respiration.

5. (A) Oxygen
Photosynthesis requires carbon dioxide, water, sunlight, and chlorophyll pigments to produce simple carbohydrates within plant cells. Oxygen is not an essential reactant or starting factor required to drive this process; rather, molecular oxygen is produced and evolved as an metabolic byproduct during the light-dependent photolysis reaction of water molecules.

6. (D) By forming temporary extensions called pseudopodia
Amoeba is a unicellular organism that ingests food through a process called phagocytosis. It extends temporary cytoplasm-filled projections called pseudopodia, or false feet, around nearby microscopic food particles. These pseudopodia gradually fuse together to completely enclose the ingested prey, forming an internal membrane-bound food vacuole where intracellular digestion proceeds.

7. (B) Cuscuta growing on a living host plant
Parasitic nutrition occurs when an organism derives its nutrients directly from another living organism, known as the host, usually causing harm without immediately killing it. Cuscuta, commonly called dodder, is a non-photosynthetic parasitic plant that uses specialized root-like structures called haustoria to penetrate host tissues and absorb water and nutrients.

8. (C) Buccal cavity
Carbohydrate digestion begins in the buccal cavity, or oral cavity, during mastication. Salivary glands secrete saliva containing the digestive enzyme salivary amylase, also known as ptyalin. This enzyme hydrolyzes complex starch molecules into simpler disaccharides such as maltose, initiating chemical breakdown before the ingested food passes further into the stomach.

9. (D) Breakdown of complex starch into simpler sugars
Salivary amylase is a carbohydrate-digesting digestive enzyme secreted into the mouth cavity by salivary glands. Its specific catalytic role is to cleave alpha-1,4 glycosidic bonds in complex dietary starches and glycogen, converting these long polysaccharidic chains into smaller

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disaccharide molecules like maltose, isomaltose, and short dextrins for further intestinal digestion.

10. (B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
The gastric mucosa secretes mucus that coats the stomach lining, preventing autolysis and chemical erosion from concentrated hydrochloric acid and pepsin. Separately, hydrochloric acid lowers gastric pH, creating an acidic environment required to convert inactive pepsinogen into active pepsin. Both physiological mechanisms are true, but acid activation does not explain mucosal protection.

11. (B) Liver
The liver is the largest internal organ in the human body responsible for manufacturing bile juice. Bile contains organic bile salts and pigments, though no digestive enzymes. Once produced by hepatocytes, bile is collected and temporarily concentrated within the gall bladder before being released into the duodenum to facilitate fat digestion.

12. (B) To increase surface area for absorbing digested food
Villi are tiny, finger-like mucosal projections present on the inner epithelial wall of the small intestine. Their primary physiological role is to tremendously expand the internal surface area available for nutrient absorption. This structural enlargement enables maximum uptake of digested simple sugars, amino acids, fatty acids, and essential minerals into circulation.

13. (A) Absorption of water from undigested food
The large intestine primarily receives undigested and unabsorbed food residue passing from the small intestine. Its chief functional role is absorbing excess water, electrolytes, and dissolved mineral salts from this remaining waste material. This process converts fluid chyme into semi-solid feces stored in the rectum prior to final egestion.

14. (C) Lipase
Lipase is a digestive enzyme secreted by the pancreas and small intestine that acts on lipid substrates. Prior to enzymatic action, bile salts emulsify large dietary fat droplets into tiny lipid droplets. Lipase then hydrolyzes these emulsified fat droplets into absorbable monomeric components, specifically free fatty acids and glycerol molecules.

15. (D) Mouth, Oesophagus, Stomach, Small Intestine, Large Intestine
Human digestion proceeds through a continuous alimentary canal. Food enters the mouth for mechanical grinding and initial starch hydrolysis, moves through the tubular oesophagus into the stomach for protein breakdown, enters the small intestine for complete enzymatic digestion and nutrient absorption, and finally enters the large intestine for water absorption.

16. (C) A diet containing balanced amounts of all essential nutrients
A balanced diet is defined as a nutritional intake that supplies carbohydrates, proteins, fats, vitamins, minerals, water, and dietary fiber in appropriate proportional amounts. It fulfills daily caloric needs while supporting metabolic processes, tissue growth, physiological repair, and disease prevention, preventing both nutritional deficiencies and metabolic toxicity or excess.

17. (B) Night blindness
Vitamin A, or retinol, plays an essential biochemical role in synthesized photoreceptor pigments, specifically rhodopsin, located within retinal rod cells of the eye. A chronic deficiency in dietary Vitamin A impairs low-light optical adaptation, leading directly to nyctalopia, commonly referred to as night blindness, and potential corneal drying disorders.

18. (D) Iodine
Iodine is an essential trace mineral required by the thyroid gland to synthesize thyroid hormones, namely thyroxine and triiodothyronine. Deficiency of iodine impairs thyroid hormone production, prompting compensatory pituitary stimulation that leads to thyroid enlargement. This abnormal swelling of the thyroid gland in the neck is clinically known as goitre.

19. (A) Proteins
Kwashiorkor is a form of severe protein-energy malnutrition observed primarily in young children. It occurs when a child's diet is markedly deficient in dietary protein, even if total caloric intake from carbohydrates is adequate. Symptoms include abdominal swelling due to edema, muscle loss, skin lesions, stunted development, and sparse hair.

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20. (C) A long small intestine for digesting cellulose
Herbivorous animals eat plant matter, which contains complex structural carbohydrates like cellulose. Digesting cellulose is biochemically challenging and requires prolonged transit time along with symbiotic microbial fermentation. Consequently, herbivores evolved a significantly longer small intestine relative to carnivores, allowing adequate time and surface area for complete cellular absorption of nutrients.

21. (A) To break down partially digested plant material
Ruminant herbivores quickly ingest fibrous plant vegetation, passing it into the rumen for initial bacterial fermentation. Later, while resting, they regurgitate this partially digested plant mass, called cud, back into the oral cavity. Chewing the cud breaks plant fibers mechanically, increasing surface area for microbial enzymes to ferment structural cellulose.

22. (A) P-2, Q-1, R-4, S-3
Enzymatic digestion involves specific enzymes targeting macronutrients at distinct locations along the digestive tract. Pepsin digests proteins inside the acidic stomach, whereas amylase hydrolyzes dietary starch within the oral cavity. Lipase breaks down emulsified lipid fats in the small intestine, and trypsin continues protein cleavage within the alkaline intestinal lumen.

23. (B) Stomata
Stomata are microscopic pores located primarily on the lower epidermal layer of plant leaves. They serve as the principal pathway for gas exchange required for photosynthesis and cellular respiration. Carbon dioxide enters through stomatal pores into mesophyll tissues, while oxygen generated as a photosynthetic byproduct diffuses out into atmospheric air.

24. (C) Chloroplast
Chloroplasts are membrane-bound plant organelles that serve as the specialized cellular site for photosynthesis. They contain light-absorbing pigments, primarily chlorophyll, embedded within thylakoid membranes. Within chloroplasts, light reactions convert solar energy into chemical energy, and light-independent dark reactions assimilate inorganic carbon dioxide into energy-rich organic carbohydrates like glucose.

25. (D) ATP
Cellular respiration involves the enzymatic oxidation of organic nutrient molecules like glucose inside living cells. The chemical energy liberated during these catabolic reactions is captured and stored by phosphorylating adenosine diphosphate into adenosine triphosphate, or ATP. ATP acts as the universal cellular energy currency powering vital biological processes.

26. (A) Rhizobium bacteria in leguminous root nodules
Symbiosis is a close biological interaction where both participating organisms derive mutual benefits. Rhizobium bacteria inhabit root nodules of leguminous plants, converting atmospheric nitrogen gas into soluble nitrates that the host plant absorbs. In exchange, the host plant provides Rhizobium bacteria with synthesized organic carbohydrates and protective habitat structures.

27. (B) They are a symbiotic algal-fungal association
Lichens represent a classic mutualistic symbiotic partnership between a photosynthetic algal or cyanobacterial partner and a heterotrophic fungal partner. The photobiont algal cells perform photosynthesis to synthesize organic carbohydrates, while the fungal mycobiont provides structural anchoring, retains environmental moisture, and absorbs essential mineral nutrients from the substrate.

28. (A) II, I, V, IV, III
Holozoic nutrition in single-celled Amoeba follows five sequential physiological steps. Ingestion occurs first as pseudopodia engulf prey, followed by digestion within a food vacuole. Next, nutrient absorption transports simple compounds into the cytoplasm, assimilation utilizes these nutrients for cellular metabolism and growth, and egestion expels undigested waste residue externally.

29. (A) Vitamin C
Vitamin C, or ascorbic acid, is an essential water-soluble nutrient crucial for collagen synthesis, tissue repair, and immune function. A structural deficiency of Vitamin C in the human diet causes scurvy, a disorder characterized by fragile blood vessels, bleeding gums, delayed wound healing, skin petechiae, and general physical weakness.

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30. (C) Calcium
Calcium is a critical mineral element required in substantial quantities for structural biomineralization of bones and teeth. It combines with phosphate to form hydroxyapatite crystals, providing mechanical strength and structural density. In addition to skeleton formation, calcium ions play key physiological roles in muscle contraction and blood clotting pathways.

31. (D) Mango tree
Cuscuta, tapeworms, and Plasmodium are all heterotrophic parasitic organisms that rely on living host organisms to obtain preformed organic nutrients. Conversely, a mango tree is an autotrophic organism containing chlorophyll pigments, enabling it to synthesize its own organic nutrients from inorganic molecules using light energy via photosynthesis.

32. (C) Carbon dioxide is oxidized to form glucose
Photosynthesis consists of light-dependent and light-independent chemical reactions. During these reactions, chlorophyll absorbs solar radiation, water molecules undergo photolytic oxidation into oxygen gas and hydrogen ions, and light energy transforms into chemical energy. Carbon dioxide is chemically reduced, rather than oxidized, to synthesize glucose molecules during dark reactions.

33. (B) Peristalsis
Peristalsis is the automatic, wave-like sequence of coordinated muscular contractions and relaxations along the gastrointestinal tract walls. Occurring continuously within smooth muscle layers of the oesophagus, stomach, and intestines, peristaltic movements physically propel ingested food and chyme systematically downward through the alimentary canal during digestion.

34. (D) Amino acids
Dietary proteins are large macromolecular polymers composed of individual amino acid residues linked by peptide bonds. Enzymatic breakdown begins with stomach pepsin, continues with pancreatic enzymes like trypsin, and finishes with intestinal peptidases. The final biochemical end products of complete protein digestion are absorbable monomeric amino acids.

35. (C) I and III only
Gastric juice secreted by stomach mucosal glands contains hydrochloric acid, pepsinogen, and protective mucus. Hydrochloric acid provides an acidic pH necessary to convert inactive pepsinogen into active pepsin, which digests proteins, not fats. Mucus coats the inner stomach surface, safeguarding gastric epithelial cells against chemical erosion from hydrochloric acid.

36. (C) Bile juice
Chyme entering the small intestine from the stomach is highly acidic due to hydrochloric acid. Bile juice, synthesized by the liver and containing sodium bicarbonate, is released into the duodenum. Bile neutralizes gastric acidity and creates an alkaline medium required for optimal activity of pancreatic enzymes like lipase and trypsin.

37. (A) Holozoic
Holozoic nutrition is a mode of heterotrophic nutrition characterized by the intake of solid or complex organic food through ingestion. Once ingested, the complex food undergoes internal enzymatic breakdown into simple soluble compounds, which are subsequently absorbed, assimilated by body cells, and utilized for energy, growth, and tissue maintenance.

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38. (D) Vitamin D
Rickets is a bone-weakening metabolic disease affecting developing children, primarily caused by a dietary deficiency of Vitamin D or inadequate sunlight exposure. Vitamin D facilitates intestinal absorption of calcium and phosphorus; its absence prevents proper bone mineralization, producing characteristically soft, weak, and deformed skeletal bones.

39. (B) They control the opening and closing of stomata
Guard cells are specialized, kidney-shaped epidermal cells located in pairs surrounding each stomatal pore in plant leaves. By changing their turgor pressure through water influx or efflux, guard cells swell or shrink, thereby regulating the physical opening and closing of stomatal apertures to balance gas exchange and transpiration.

40. (C) Proteins and calories
Marasmus is a severe form of protein-energy malnutrition occurring predominantly in infants under one year old. It results from a pervasive deficiency in both dietary proteins and total caloric intake. Affected infants suffer from extensive tissue wasting, complete loss of subcutaneous fat, severe muscle atrophy, and stunted physical growth.

41. (D) Crow
An omnivore is an organism whose diet naturally includes both plant-derived substances and animal tissue. Crows possess flexible dietary habits, consuming plant seeds, fruits, grains, insects, small invertebrates, and carrion. This broad ecological diet distinguishes them from strict herbivores like cows and elephants or obligate carnivores like lions.

42. (A) Autotrophs
Autotrophs, such as green plants and photosynthetic algae, represent the foundational trophic level in ecological food chains as primary producers. They capture solar energy to convert inorganic compounds into chemical energy stored in organic matter. All subsequent trophic levels, including herbivores, carnivores, and decomposers, ultimately depend on autotrophs for nutrition.

43. (B) The splitting of fat globules into smaller drops by bile
Emulsification is a physical digestive process occurring in the small intestine where bile salts break down large, insoluble dietary fat globules into much smaller microscopic lipid droplets. This process significantly increases the surface area of lipids available for enzymatic degradation, allowing pancreatic lipase to break down fats efficiently.

44. (B) It digests proteins into peptides
Trypsin is a proteolytic digestive enzyme synthesized by the pancreas and secreted into the small intestine as inactive trypsinogen. Activated by enterokinase in the duodenum, trypsin acts in an alkaline environment to cleave internal peptide bonds of dietary proteins, breaking them down into smaller peptides and amino acid chains.

45. (C) Assertion (A) is true but Reason (R) is false.
The small intestine is elongated, highly coiled, and lined internally with millions of microscopic villi. These structural features function specifically to maximize the available surface area, thereby enhancing, rather than reducing, the rate and efficiency of nutrient absorption into blood and lymph vessels. Therefore, the assertion is accurate while the reason is incorrect.

46. (C) Abomasum
Ruminant animals possess a complex stomach divided into four distinct chambers: rumen, reticulum, omasum, and abomasum. The abomasum is designated as the true stomach because its mucosal lining secretes hydrochloric acid and gastric digestive enzymes like pepsin, performing chemical breakdown of ingested food similar to a non-ruminant monogastric stomach.

47. (D) Roots
Plant root systems feature extensive fine root hairs that intimately penetrate surrounding soil particles. These root structures serve as the main organs for absorbing water and dissolved inorganic minerals, such as nitrates and phosphates. Minerals are taken up across root cell membranes via passive diffusion and active transport mechanisms.

48. (C) Absorbed solar light energy
During the light-dependent phase of photosynthesis, chlorophyll molecules absorb photons from sunlight. This absorbed light energy powers the photolysis of water molecules within thylakoid membranes, splitting water into hydrogen ions, electrons, and molecular oxygen gas. This light-driven splitting supplies electrons needed to generate ATP and NADPH.

49. (B) Duodenum
The human large intestine consists of three main structural parts: the caecum, the colon, and the rectum. The duodenum is not a component of the large intestine; instead, it forms the initial C-shaped segment of the small intestine that receives chyme from the stomach along with liver and pancreatic secretions.

50. (D) I, II, III and IV
Photosynthesis encompasses a sequence of coordinated biochemical reactions. Chlorophyll first absorbs light energy, which is converted into chemical energy. Simultaneously, water

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molecules undergo photolytic splitting into hydrogen ions and oxygen gas. Finally, light-independent reactions utilize chemical energy to reduce carbon dioxide molecules into energy-rich carbohydrate sugars like glucose.

51. (A) Assimilation
Assimilation is the ultimate metabolic stage in animal nutrition where absorbed simple nutrient molecules pass from blood and lymph into body tissues. Living cells uptake these nutrients and incorporate them into intracellular protoplasm, utilizing them for cellular respiration, cellular repair, structural tissue growth, and various vital metabolic processes.

52. (D) Anaemia
Anaemia is a medical disorder defined by a reduction in total red blood cells or functional hemoglobin concentrations in blood. Hemoglobin carries oxygen to body tissues; therefore, anaemia reduces blood oxygen-carrying capacity, resulting in persistent physical fatigue, cellular hypoxia, tissue weakness, shortness of breath, and noticeable skin paleness.

53. (B) Calorie
In nutritional science, energy content stored within dietary food is traditionally quantified using calories or kilocalories. One calorie represents the thermal energy required to elevate the temperature of one gram of pure water by one degree Celsius. This unit measures the chemical energy made available through metabolic oxidation.

54. (C) Iron
Iron is an essential trace element required for synthesizing hemoglobin, the iron-containing oxygen-transport protein inside red blood cells. A prolonged dietary deficiency in iron directly impairs hemoglobin production, diminishing oxygen transport capabilities in systemic circulation and resulting in iron-deficiency anaemia characterized by weakness and fatigue.

55. (A) Dietary fibre
Dietary fibre, also known as roughage, consists mostly of indigestible plant carbohydrates like cellulose. Although human digestive enzymes cannot break down roughage to yield metabolic energy, it adds necessary bulk to intestinal contents, retains moisture, promotes regular peristaltic contractions, and prevents constipation along the digestive tract.

56. (B) The stomatal pore opens
Stomatal opening is driven by changes in guard cell turgidity. When surrounding water enters guard cells via osmosis, their internal turgor pressure increases, causing them to swell. Because the inner cell walls facing the pore are thicker and less elastic than outer walls, the swelling guard cells curve outward, opening the stomatal pore.

57. (D) Canines
Carnivorous mammals possess structural dental adaptations tailored for capturing prey and tearing flesh. Canines are pointed, elongated teeth situated between incisors and premolars. Their sharp, conical design provides necessary mechanical strength to pierce, grip, hold, and tear tough meat fibers away from animal prey during feeding.

58. (C) Digestion
Digestion is the physiological process of breaking down complex, insoluble dietary molecules into small, soluble, and absorbable forms. Through mechanical grinding and enzymatic hydrolysis, macromolecules like starches, proteins, and lipids are converted into simple sugars, amino acids, and fatty acids capable of crossing intestinal cell membranes.

59. (D) Yeast
Yeast is a unicellular fungus exhibiting a saprophytic mode of nutrition. Lacking photosynthetic pigments like chlorophyll, yeast cannot produce its own organic food. Instead, it secretes digestive enzymes onto external non-living organic substrates, breaking down complex nutrients externally and absorbing dissolved simple compounds directly across its cell membrane.

60. (B) By secreting bile to emulsify fats
Although the liver produces no digestive enzymes, it plays a vital digestive role by synthesizing bile juice. Bile contains organic bile salts that break down large insoluble fat globules into smaller microscopic droplets through emulsification. This physical dispersion greatly increases lipid surface area, accelerating enzymatic breakdown by pancreatic lipase.

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61. (A) Heterotrophs use sunlight to make glucose.
Heterotrophic organisms lack chlorophyll and cannot perform photosynthesis to synthesize glucose from inorganic substances using sunlight. Instead, heterotrophs obtain organic nutrients by consuming other organisms or organic matter. In contrast, utilizing sunlight to synthesize glucose is an autotrophic process characteristic of green plants and photosynthetic algae.

62. (D) Stomata
Stomata are microscopic pores distributed across the leaf surface, bounded by specialized guard cells. They function as the chief structural sites for gaseous exchange in plants, allowing atmospheric carbon dioxide to diffuse into photosynthetic mesophyll tissue while permitting oxygen gas and transpired water vapor to diffuse outward.

63. (B) Vitamin D
Vitamin D, or cholecalciferol, can be synthesized naturally in human skin cells when exposed to ultraviolet B radiation from sunlight. Solar energy triggers the chemical conversion of 7-dehydrocholesterol within skin epidermal layers into provitamin D3, which subsequently undergoes hepatic and renal hydroxylations to yield active functional Vitamin D.

64. (C) It completes digestion of all major nutrients.
Intestinal juice, or succus entericus, is secreted by glands in the small intestine mucosa. It contains a full complement of digestive enzymes, including peptidases, maltase, sucrase, lactase, and intestinal lipases. These enzymes complete the biochemical breakdown of partially digested carbohydrates, proteins, and fats into absorbable monomers.

65. (D) Rectum
The rectum is the terminal muscular segment of the large intestine preceding the anal canal. It serves as a temporary storage reservoir for indigestible food residues, bacteria, and waste products formed into feces. When distended by accumulating fecal mass, stretch receptors trigger neural signals initiating the defecation reflex.

66. (A) Translocation
Translocation refers to the long-distance transport of soluble organic products of photosynthesis, primarily sucrose, through phloem vascular tissues in plants. This active transport process delivers energy-rich carbohydrates from photosynthetic source organs, like leaves, to metabolic sink regions, including growing roots, stems, flowers, seeds, and storage organs.

67. (A) P-3, Q-1, R-2, S-4
Essential dietary vitamins prevent specific nutritional deficiency disorders. A deficiency in Vitamin A causes night blindness by impairing visual pigments, Vitamin B_1 deficiency causes beriberi affecting nerve function, Vitamin C deficiency leads to scurvy with bleeding gums, and Vitamin D deficiency causes rickets resulting in soft bones.

68. (B) Chlorophyll
Chlorophyll is a green photosynthetic pigment contained within thylakoid membranes inside plant chloroplasts. It plays a critical biochemical role by absorbing photons from blue and red light spectrums. This captured light energy is subsequently converted into chemical energy during light-dependent reactions, driving carbohydrate synthesis in photosynthesis.

69. (D) Plasmodium - Parasite
Plasmodium is a protozoan parasite that causes malaria, obtaining nutrients by living inside host red blood cells and liver tissue. In contrast, Amoeba displays holozoic nutrition, Cuscuta is a parasitic non-autotrophic plant, and mushrooms exhibit saprotrophic nutrition by decomposing dead organic matter rather than holozoic feeding.

70. (A) Egestion
Egestion is the physiological process of removing undigested and unabsorbed food residues from the alimentary canal of an organism. In humans, egestion occurs through the anus as defecation, whereas in single-celled organisms like Amoeba, egestion occurs when a food vacuole fuses with the plasma membrane to discharge waste.

71. (D) Fatty acids and glycerol
Dietary fats are primarily composed of triglycerides, which are esters formed from glycerol and fatty acid chains. During digestion in the small intestine, bile emulsifies large fat globules, and pancreatic lipase chemically cleaves ester bonds. Complete enzymatic hydrolysis converts triglycerides into their constituent end products: free fatty acids and glycerol.

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72. (B) Duodenum
The duodenum is the proximal, C-shaped segment of the small intestine connected directly to the stomach's pylorus. It receives acidic chyme from the stomach and serves as the entry site for hepatopancreatic secretions, receiving bile from the liver via the bile duct and digestive enzymes from the pancreas via the pancreatic duct.

73. (B) Vitamin C
Vitamins are classified based on solubility into fat-soluble and water-soluble groups. Vitamin C, or ascorbic acid, along with B-complex vitamins, is water-soluble, meaning excess amounts are excreted in urine rather than stored long-term. Conversely, Vitamins A, D, E, and K are fat-soluble compounds stored in body tissues.

74. (C) They fix nitrogen into usable forms for plants.
Rhizobium bacteria establish a mutualistic symbiotic relationship inside root nodules of leguminous plants. Inert atmospheric nitrogen gas cannot be absorbed directly by plant leaves or roots; Rhizobium fixes inert gaseous nitrogen into bioavailable nitrogenous compounds like ammonia and nitrates, which the plant utilizes for protein and nucleic acid synthesis.

75. (D) Nutrition supplies glucose oxidized in respiration for energy.
Nutrition and respiration are interconnected metabolic processes essential for life. Nutrition involves ingesting, digesting, and absorbing organic nutrients like glucose into cells. Cellular respiration subsequently oxidizes these absorbed glucose molecules in the presence or absence of oxygen, releasing stored chemical energy in the form of ATP to power biological activities.

76. (C) I and III only
Amoeba is a single-celled eukaryotic organism that lacks a specialized digestive tract or organ system. It captures prey using pseudopodia and forms temporary intracellular food vacuoles. Digestive enzymes enter the food vacuole to hydrolyze enclosed nutrients, demonstrating intracellular digestion without requiring complex digestive organs found in multicellular animals.

77. (B) Ingesting complex organic matter and digesting it internally
Holozoic nutrition is a heterotrophic nutrition mode where organisms ingest solid or liquid organic food particles into their body. Once swallowed, the food undergoes internal mechanical and chemical digestion by hydrolytic enzymes, yielding simple soluble nutrients that are absorbed into cells and assimilated for energy and tissue growth.

78. (A) Pepsinogen
Gastric chief cells in the stomach mucosal lining secrete pepsinogen, an inactive zymogen precursor, to prevent autolysis of stomach wall proteins. Upon contact with hydrochloric acid secreted by parietal cells in the gastric lumen, pepsinogen undergoes conformational cleavage into active pepsin, initiating protein digestion into smaller peptides.

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79. (D) Nitrogen
Nitrogen is an essential plant macronutrient required in substantial quantities for vegetative development. It forms an indispensable constituent of structural proteins, nucleic acids like DNA and RNA, cellular enzymes, and chlorophyll pigments. In contrast, elements like zinc, copper, and manganese are micronutrients required in tiny trace amounts.

80. (C) Solar energy
Solar energy is the primary driving force for virtually all terrestrial and aquatic food chains on Earth. Photosynthetic organisms like plants, algae, and cyanobacteria absorb radiant solar energy and convert it into stored chemical energy in organic molecules, which flow sequentially through primary consumers, secondary consumers, and decomposers.

81. (B) Cow
Cows are ruminant herbivores possessing a specialized four-chambered stomach consisting of the rumen, reticulum, omasum, and abomasum. This complex anatomical adaptation enables continuous microbial fermentation of plant cellulose within the rumen, breaking down tough fibrous plant cell walls into digestible short-chain fatty acids that supply energy to the cow.

82. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Herbivores possess a significantly longer small intestine than carnivores because plant tissue contains cellulose, which requires extended time and symbiotic microbial fermentation to break down. Meat consumed by carnivores consists

mostly of proteins and fats, which are structurally easier to digest, necessitating a shorter intestinal tract for efficient absorption.

83. (C) Oesophagus
The oesophagus, or food pipe, is a muscular tube connecting the pharynx to the stomach. Lined with smooth muscle layers, it transports swallowed food boluses from the oral cavity into the gastric cavity through rhythmic, wave-like muscular contractions known as peristalsis, without secreting digestive enzymes or performing chemical breakdown.

84. (D) Cellulose
Cellulose is a structural polysaccharide composed of glucose monomers connected by beta-1,4 glycosidic linkages. The human digestive tract cannot synthesize or secrete cellulase, the enzyme required to hydrolyze these beta linkages. Consequently, dietary cellulose remains indigestible in humans, passing through the alimentary canal as beneficial dietary fiber.

85. (D) Pyloric sphincter
The pyloric sphincter is a ring of smooth muscle located at the junction between the stomach's pylorus and the small intestine's duodenum. It acts as a regulatory valve that controls gastric emptying, allowing small, regulated amounts of acidic chyme to pass incrementally into the small intestine for further chemical digestion.

86. (A) Vitamins A, D, E, and K
Vitamins A, D, E, and K are fat-soluble vitamins soluble in lipids and absorbed along with dietary fats across intestinal membranes. Excess quantities are stored in adipose tissue and the liver for future physiological needs. In contrast, Vitamin C and B-complex vitamins are water-soluble and excreted regularly in urine.

87. (B) Vitamin C
Swollen, bleeding gums, petechiae, joint pain, and delayed wound healing are characteristic clinical signs of scurvy, caused by a nutritional deficiency of Vitamin C. Ascorbic acid is necessary for hydroxylating proline and lysine residues during collagen biosynthesis; defective collagen leads to vascular fragility and connective tissue breakdown.

88. (C) Action of salivary amylase → Action of pepsin → Emulsification of fats
Human digestion proceeds sequentially along the digestive tract. Starch digestion begins first in the oral cavity through salivary amylase. Next, swallowed food enters the acidic stomach, where pepsin initiates protein hydrolysis. Subsequently, food enters the small intestine, where bile salts emulsify large fat globules prior to intestinal lipid breakdown.

89. (D) Leaf lamina
The leaf lamina, or leaf blade, is the expanded, flattened portion of a leaf providing a broad surface area optimized to absorb incident sunlight. Its broad and thin morphology maximizes photon capture by photosynthetic pigments while minimizing diffusion distance for atmospheric carbon dioxide entering through stomatal pores into internal mesophyll layers.

90. (A) Water
Oxygen gas released during photosynthesis originates exclusively from water molecules. During light-dependent reactions in thylakoid membranes, absorbed solar energy drives photolysis, splitting water molecules into hydrogen ions, free electrons, and oxygen gas. Carbon dioxide absorbed by leaves is used later during light-independent dark reactions to construct glucose.

91. (C) Small intestine
The small intestine is the principal organ responsible for absorbing digested nutrients in humans. Its extensive length, circular mucosal folds, villi, and dense microvilli create a massive surface area. Capillaries and lacteals within villi absorb monomeric nutrients like glucose, amino acids, and fatty acids directly into systemic circulation.

92. (D) Gall bladder - Acid
The gall bladder is a muscular sac that stores and concentrates alkaline bile synthesized by the liver; it does not produce or secrete acid. Acid production in the human digestive system occurs exclusively within the stomach, where parietal cells secrete hydrochloric acid to create an acidic gastric environment for digestion.

93. (A) It forms the center of chlorophyll molecules.
Magnesium is an essential macronutrient in plant biology because it serves as the central

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coordinating metal atom within the porphyrin ring of chlorophyll molecules. Without adequate magnesium, plants cannot synthesize sufficient chlorophyll, leading to interveinal chlorosis, reduced light capture capacity, and significantly impaired photosynthetic rates.

94. (A) I, II and III only
The pancreas functions as both an exocrine and endocrine gland. Its endocrine islets of Langerhans secrete hormones like insulin and glucagon into blood to regulate glucose homeostasis. Its exocrine acini secrete pancreatic juice containing enzymes like trypsin and lipase into the duodenum. Bile is produced by the liver, not the pancreas.

95. (D) Goitre
Goitre is characterized by an abnormal enlargement of the thyroid gland in the neck region. It occurs primarily due to a prolonged dietary deficiency of iodine, an element necessary for synthesizing thyroid hormones. Lacking iodine, the pituitary gland continuously secretes thyroid-stimulating hormone, causing hypertrophy and hyperplasia of thyroid tissue.

96. (C) Hydrochloric acid
Gastric juice secreted by stomach mucosal glands contains concentrated hydrochloric acid. In addition to activating pepsinogen into pepsin, hydrochloric acid creates a strongly acidic environment with a pH between 1.5 and 3.5. This low pH kills ingested bacteria and pathogens entering with food, serving as a biological defense mechanism.

97. (A) Both plants and animals
Omnivores are heterotrophic organisms whose natural diet consists of both plant-derived foods and animal tissues. Their digestive systems, dentition, and metabolic enzymes are structurally and functionally adapted to process diverse organic food sources, including vegetation, seeds, fruits, insects, and animal meat, ensuring broad nutritional flexibility in ecosystems.

98. (D) Blood type
Calculating an individual's daily caloric requirement depends on basal metabolic rate and daily energy expenditure. Factors influencing energy needs include age, sex, body weight, height, and physical activity levels. An individual's ABO blood type is a genetic antigen marker that has no scientific effect on caloric needs or metabolic expenditure.

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99. (C) Sleep
The human body's metabolic energy requirement reaches its lowest level during sleep. In this resting state, skeletal muscle activity is minimal, heart rate and respiration rates slow down, and sensory processing decreases, leaving energy expenditure focused primarily on basal metabolic functions like cellular maintenance, tissue repair, and organ performance.

100. (C) Iodine solution
Iodine solution is used as a specific chemical indicator to test for starch in plant tissues. When iodine solution contacts starch, iodine molecules slip inside helical amylose polymer chains, forming a starch-iodine complex. This chemical interaction produces a distinct dark blue-black color change, confirming the presence of starch reserves in tested leaves.

101. (A) II, IV, III, I
A cross-section of a typical dicot leaf reveals structural tissue layers arranged in order from top to bottom. The uppermost surface is protected by the upper epidermis, followed by closely packed palisade mesophyll cells specialized for photosynthesis. Below lies loosely arranged spongy mesophyll cells with intercellular air spaces, bounded by the lower epidermis.

102. (B) Rumen
The rumen is the largest chamber of the ruminant stomach system. While grazing, ruminant animals quickly swallow large quantities of unchewed plant foliage, storing it in the rumen. Symbiotic anaerobic bacteria, protozoa, and fungi inside the rumen begin fermenting complex plant cellulose, softening the food before it is regurgitated for re-mastication.

103. (B) Soil mineral concentration is lower than in root cells
Mineral absorption by plant roots occurs largely via active transport because dissolved mineral concentrations in soil solution are typically much lower than inside root epidermal cell cytoplasm. Moving mineral ions against their concentration gradient into root tissues requires metabolic energy supplied by ATP generated through root cellular respiration.

104. (C) Tapeworm
A tapeworm is an obligate endoparasite inhabiting the digestive tract of host vertebrates. Lacking its own digestive system, the tapeworm absorbs pre-digested nutrients directly through its body wall, or tegument, from host intestinal fluid. This complete dependence on a living host for survival represents an obligate parasitic mode of nutrition.

105. (A) P-2, Q-4, R-1, S-3
Organisms are categorized by their nutritional strategies. Autotrophs synthesize organic nutrients internally, whereas heterotrophs cannot produce food and consume external organic matter. Saprophytes obtain nutrients by decomposing non-living organic matter, and parasites derive nutrients directly from living host organisms, often causing harm without immediate mortality.

106. (C) Fats
Among primary macronutrient groups, fats yield the highest energy density per unit weight. Complete oxidation of dietary fats yields approximately 9 kilocalories per gram, whereas carbohydrates and proteins yield roughly 4 kilocalories per gram. This higher energy content stems from the highly reduced hydrocarbon state of fatty acid chains.

107. (A) Epiglottis
The epiglottis is a flexible, leaf-shaped cartilaginous flap located at the root of the tongue, directly above the laryngeal opening. During swallowing, the larynx elevates and the epiglottis automatically folds downward to cover the glottis, preventing food or liquids from entering the respiratory trachea and directing food safely into the oesophagus.

108. (B) Cellulose
Cellulose is a complex structural carbohydrate consisting of unbranched glucose chains linked by beta-1,4 glycosidic bonds, forming the primary component of plant cell walls. Because humans lack cellulase enzymes to hydrolyze these beta bonds, cellulose passes undigested through the human gut, serving as vital dietary fiber or roughage.

109. (D) Marasmus
Marasmus is a severe form of protein-energy malnutrition occurring predominantly in infants under one year old due to combined deficiencies of dietary protein and total calories. Clinical characteristics include severe emaciation, loss of subcutaneous fat, muscle wasting, dry wrinkled skin, and an old-looking, shriveled appearance with stunted physical growth.

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110. (C) Egestion
Single-celled Amoeba eliminates indigestible waste through egestion. Following intracellular digestion within a food vacuole, absorbable simple nutrients diffuse into cytoplasm. The residual food vacuole containing indigestible waste moves to the cell membrane, fuses with the plasma membrane, and ruptures externally to expel solid waste into the aquatic surrounding.

111. (B) Lymph in lacteals
Digested dietary fats are re-esterified within intestinal epithelial cells into chylomicrons, which are fat droplets too large to enter blood capillaries directly. Instead, chylomicrons enter specialized lymphatic capillaries called lacteals located in intestinal villi. Lymphatic fluid transports these absorbed lipids through the thoracic duct into venous blood circulation.

112. (B) Intake of carbon dioxide, release of oxygen
During daytime daylight hours, photosynthetic activity in green leaf mesophyll cells proceeds at a substantially higher rate than cellular respiration. Consequently, plants absorb atmospheric carbon dioxide through open stomatal pores for photosynthetic sugar production and release excess molecular oxygen gas produced by water photolysis as a net gaseous byproduct.

113. (A) Thylakoids
Chlorophyll is embedded within photosynthetic protein complexes located inside internal thylakoid membranes of chloroplasts. These flattened, disc-like membrane sacs stack to form grana, anchoring chlorophyll pigments alongside electron transport chains. This arrangement allows light energy absorption and powers initial light-dependent reactions of photosynthesis.

114. (C) Glycogen
Glycogen is a highly branched polysaccharide composed of glucose units that serves as the chief storage carbohydrate in animals. Synthesized through glycogenesis, glycogen reserves accumulate predominantly within liver hepatocytes and skeletal muscle fibers.

When blood glucose drops, glycogen undergoes enzymatic hydrolysis to release free glucose into the blood.

115. (C) Assertion (A) is true but Reason (R) is false.
Bile contains bile salts and pigments but lacks digestive enzymes, yet plays a crucial digestive role by emulsifying large fat droplets into microscopic droplets. However, bile is alkaline due to sodium bicarbonate; it neutralizes acidic gastric chyme, creating an alkaline intestinal medium rather than an acidic medium. Thus, the assertion is true but the reason is false.

116. (B) Scurvy
Citrus fruits like oranges, lemons, limes, and grapefruits contain high concentrations of ascorbic acid, or Vitamin C. Consuming citrus fruits prevents and cures scurvy, a deficiency disease marked by defective collagen synthesis, capillary fragility, swollen bleeding gums, delayed wound healing, joint pain, and subcutaneous hemorrhages.

117. (A) Carbon dioxide
Autotrophs utilize simple inorganic molecules from the environment to synthesize complex organic energy sources. Carbon dioxide gas absorbed from the atmosphere serves as the carbon source for autotrophic nutrition, while soil water provides hydrogen. Photosynthetic enzymes fix inorganic carbon dioxide into organic carbohydrates like glucose using solar energy.

118. (C) It adds bulk and promotes smooth bowel movements.
Dietary roughage consists of indigestible plant fibers, primarily cellulose, that pass through the human digestive tract without chemical breakdown. Although roughage provides no metabolic calories, it absorbs water, increases fecal mass, stimulates intestinal peristaltic contractions, and ensures smooth bowel transit, effectively preventing intestinal stasis and constipation.

119. (D) Saprotrophic
Mushrooms are non-photosynthetic fungi exhibiting saprotrophic nutrition. Lacking chlorophyll, they cannot synthesize organic nutrients. Instead, mushroom mycelia release extracellular digestive enzymes onto decaying plant matter, leaf litter, or dead logs, breaking down complex polymers externally before absorbing dissolved simple organic nutrients across fungal hyphae walls.

120. (C) Fatty acids
Hydrophilic nutrients like monosaccharides, amino acids, water, and minerals absorb directly across intestinal epithelium into capillary networks inside villi. In contrast, hydrophobic fatty acids and glycerol reassemble within epithelial cells into chylomicrons, entering lymphatic lacteals rather than blood capillaries before discharging into the bloodstream.

121. (A) I only
Carbohydrate digestion begins in the mouth via salivary amylase and is completed in the small intestine by pancreatic amylase and intestinal disaccharidases; it is not finished in the stomach. The large intestine secretes no digestive enzymes, and saliva contains amylase. Therefore, statement I is incorrect while statements II and III are correct.

122. (C) Enamel
Tooth enamel forms the hard, translucent outer protective layer covering the anatomical crown of a tooth. Composed of over 95 percent inorganic hydroxyapatite mineral crystals, enamel represents the hardest and most mineralized biological substance in the human body, enduring mechanical wear during chewing and biting food.

123. (A) Detergent breaking up grease
The primary digestive action on dietary lipids involves bile salt emulsification followed by lipase activity, breaking down large insoluble fat masses into smaller droplets. This physical process mirrors how household detergents break down grease into small suspended droplets, increasing contact area for degradation in water-based media.

124. (C) Nitrogen
Nitrogen is an essential plant macronutrient absorbed primarily by root systems in the form of inorganic nitrate and nitrite ions, or ammonium ions, dissolved in soil solution. Plants utilize absorbed nitrogen to synthesize amino acids, structural proteins, nucleic acids, chlorophyll pigments, and various essential metabolic enzymes.

125. (B) Mycorrhiza
Mycorrhiza is a mutualistic symbiotic association formed between soil fungi and the

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roots of vascular plants. The extensive fungal hyphal network greatly extends root surface area, enhancing absorption of soil minerals like phosphorus and nitrogen for the host plant. In return, the plant supplies synthesized organic carbohydrates to the fungus.

126. (B) Proteins
Proteins are fundamental macronutrients composed of amino acid chains that serve as primary structural building blocks of human cells and tissues. They are necessary for cell membrane structure, muscle tissue synthesis, cellular enzyme production, systemic hormone regulation, tissue repair, and overall structural body growth throughout life.

127. (B) Dietary fats
Surgical removal of the gall bladder, known as a cholecystectomy, eliminates the organ that stores and concentrates hepatic bile. Without a storage reservoir, bile drips continuously but diluted into the duodenum rather than releasing in concentrated bursts during meals. This impairs fat emulsification, making digestion of high-fat meals difficult.

128. (C) To reduce water loss through transpiration
The waxy cuticle is a hydrophobic, non-cellular layer synthesized by epidermal cells covering external leaf surfaces. Its primary evolutionary function is to form a waterproof physical barrier that minimizes uncontrolled cuticular transpiration and water loss, helping plants maintain internal water balance under sunny or dry atmospheric conditions.

129. (C) It stops entirely
Photosynthesis is a light-driven metabolic process dependent on solar energy to power light-dependent reactions in chloroplasts. When a plant is placed in total darkness, chlorophyll pigments cannot absorb photons to generate required ATP and NADPH. Consequently, the photosynthetic process halts completely, forcing the plant to rely on stored carbohydrates for respiration.

130. (C) Kwashiorkor
A distinct clinical triad of abdominal edema producing a pot-belly appearance, thin wasted limbs, skin pigmentation changes, sparse reddish hair, and poor mental development characterizes Kwashiorkor. This nutritional disorder affects young children whose diet contains sufficient carbohydrates but suffers from a severe deficiency of essential dietary proteins.

131. (A) Using absorbed nutrients to build cell tissues
Assimilation in human nutrition is the cellular process where absorbed simple nutrients, like amino acids, glucose, and fatty acids, enter systemic cells from blood circulation. Cells incorporate these compounds into cytoplasm and cellular components, utilizing them to synthesize structural proteins, cellular organelles, and tissue structures for energy, growth, and repair.

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132. (A) I, II and III
Carbohydrates yield approximately 4 kilocalories per gram and serve as the human body's primary immediate energy source, encompassing simple sugars and complex starches. Carbohydrates are digested into monosaccharides like glucose, not amino acids, which come from protein digestion. Thus, statements I, II, and III are correct regarding carbohydrates.

133. (C) Fats → Fatty acids
During human digestive hydrolysis, large organic macromolecules are cleaved into specific absorbable monomeric components. Complete digestion of dietary fats yields free fatty acids and glycerol molecules. In contrast, dietary proteins hydrolyze into amino acids, complex starches breakdown into glucose, and maltose converts into individual glucose units.

134. (C) Amoeba
Amoeba is a single-celled protozoan that lacks specialized tissues, organs, or a digestive system. It performs intracellular digestion within temporary microscopic food vacuoles formed by engulfing food particles via pseudopodia. In contrast, humans, cows, and fish are multicellular organisms possessing complex, specialized alimentary canals for extracellular digestion.

135. (C) Respiration
Cellular respiration is the universal biochemical process where organic nutrients, predominantly glucose, undergo enzymatic oxidation inside living cells. This catabolic process breaks chemical bonds within nutrient molecules, liberating energy captured in ATP to drive cellular functions, while producing carbon dioxide and water as metabolic products.

136. (C) Thyroid
The thyroid gland, located in the neck, requires dietary iodine to synthesize thyroid hormones: thyroxine and triiodothyronine. Follicular cells within the thyroid absorb iodide ions from blood and incorporate them into tyrosine residues. Deficiency in iodine leads to impaired thyroid hormone production and compensatory thyroid enlargement, known as goitre.

137. (D) None of the above; all are present
Healthy adult humans possess a heterodont dentition consisting of four distinct types of teeth in each jaw quadrant: incisors for cutting, canines for tearing, premolars for crushing, and molars for grinding. No tooth category is missing from a complete permanent adult dentition, which totals thirty-two teeth.

138. (B) Bile duct
The bile duct system consists of hepatic and cystic ducts that join to form the common bile duct. This muscular tube carries bile synthesized by liver hepatocytes to the gall bladder for temporary storage and subsequently delivers concentrated bile into the duodenal lumen of the small intestine to assist in lipid emulsification.

139. (D) Four
Ruminant herbivores, such as cows, sheep, and goats, feature a specialized stomach divided into four distinct anatomical compartments: the rumen, reticulum, omasum, and abomasum. This multi-chambered gastric structure enables efficient storage, regurgitation, re-mastication, and microbial fermentation of tough, cellulose-rich plant vegetation.

140. (A) P-2, Q-4, R-3, S-1
Each gastrointestinal organ performs specialized functions. The stomach churns ingested food and secretes gastric pepsin for protein breakdown, the small intestine serves as the primary site for nutrient absorption into circulation, the large intestine reabsorbs excess water from indigestible waste, and the liver continuously synthesizes fat-emulsifying bile juice.

141. (B) Rickets
Rickets is a metabolic bone disorder affecting growing children, caused by a nutritional deficiency of Vitamin D, calcium, or phosphate. Insufficient Vitamin D impairs intestinal calcium absorption, leading to defective osteoid mineralization. Consequently, weight-bearing bones become soft, weak, and subject to structural bending, causing bowed legs and skeletal deformities.

142. (B) Beriberi
Polishing rice removes the outer pericarp and aleurone layers, which contain abundant thiamine, or Vitamin B_1. Consuming a restrictive diet consisting almost entirely of polished white rice leads to thiamine deficiency, resulting in beriberi. This nutritional disease causes peripheral nerve damage, muscle weakness, loss of appetite, and cardiovascular complications.

143. (A) Carbon dioxide
Green plants utilize atmospheric carbon dioxide gas as the essential inorganic carbon source for photosynthesis. Carbon dioxide diffuses into leaves through open stomatal pores and enters chloroplast stroma, where photosynthetic enzymes fix carbon during light-independent dark reactions to synthesize energy-rich carbohydrate molecules like glucose.

144. (B) Photosynthesis and respiration
Photosynthesis and respiration demonstrate ecological interdependence between autotrophs and heterotrophs. Autotrophic photosynthesis converts carbon dioxide and water into oxygen gas and organic glucose. Heterotrophs consume these organic compounds and inhale oxygen during cellular respiration, generating carbon dioxide and water, which autotrophs recycle back into photosynthesis.

145. (A) Appendix
The vermiform appendix is a small, blind-ended pouch attached to the caecum at the junction of the small and large intestines in humans. Classified as a vestigial organ, it represents an evolutionary remnant of a larger cellulose-fermenting caecum found in ancestral herbivorous mammals, playing no major functional role in modern human digestion.

146. (C) Vitamins
Vitamins are essential organic micronutrients required by the human body in minute amounts. Although they do not yield metabolic energy directly or serve as primary structural tissue components, vitamins act as vital coenzymes and antioxidants that regulate metabolic pathways,

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cellular growth, tissue repair, and immune system performance.

147. (D) Decreased blood hemoglobin levels
Iron is a critical constituent of the heme group in hemoglobin, the red blood cell protein responsible for oxygen transport. A long-term dietary deficiency in iron limits the bone marrow's capacity to produce functional hemoglobin molecules, leading directly to reduced hemoglobin levels in blood and iron-deficiency anaemia.

148. (C) Ingestion, Digestion, Absorption, Assimilation, Egestion
Animal nutrition follows five sequential steps. Food intake occurs during ingestion, followed by digestion where complex molecules break down into simple nutrients. Next, absorption transfers simple nutrients into circulating fluids, assimilation incorporates these nutrients into body cells for metabolic activities, and egestion expels undigested waste residue.

149. (A) For the synthesis of chlorophyll
Magnesium is an essential macronutrient in plant nutrition because it forms the central coordinating atom in the chemical structure of chlorophyll. Without sufficient magnesium, plants cannot synthesize adequate chlorophyll, resulting in interveinal chlorosis of leaves, reduced light energy absorption, and severely impaired photosynthetic capacity.

150. (C) Food vacuole
In Amoeba, the food vacuole functions analogously to an animal stomach. Formed when pseudopodia enclose engulfed food during phagocytosis, the food vacuole receives digestive enzymes from surrounding cytoplasm. These hydrolytic enzymes break down captured food internally into simple soluble compounds absorbed directly into unicellular cytoplasm.

151. (C) Phototrophic
Phototrophic nutrition is an autotrophic mode of nutrition where organisms, like green plants and photosynthetic bacteria, utilize light energy to synthesize organic molecules from simple inorganic compounds. Conversely, saprophytic, parasitic, and holozoic nutrition represent heterotrophic modes where organisms rely on external organic food sources.

152. (B) Pepsin
Pepsin is a principal protein-digesting gastric enzyme secreted into the stomach as inactive pepsinogen. Pepsin requires a strongly acidic medium, typically between pH 1.5 and 2.5 maintained by gastric hydrochloric acid, to achieve optimal enzymatic conformation and catalytic activity for splitting dietary proteins into smaller peptides.

153. (A) Only the green part
Variegated leaves possess green portions containing chlorophyll and non-green portions lacking chlorophyll. When exposed to sunlight, only green regions perform photosynthesis to synthesize glucose, which accumulates as starch reserves. Subsequent starch testing with iodine produces a blue-black complex exclusively in chlorophyll-bearing green regions, leaving non-green regions brown-yellow.

154. (C) They yield twice as many calories per gram as carbohydrates.
Dietary fats yield more long-term energy than carbohydrates because their hydrocarbon chains are in a highly chemical reduced state, containing more carbon-hydrogen bonds. Metabolic oxidation of fats yields roughly 9 kilocalories per gram, more than double the 4 kilocalories per gram released by carbohydrates, providing dense long-term metabolic energy storage.

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155. (A) I and II only
Parasitic nutrition involves a parasite deriving organic nutrients at the expense of a living host organism. Ectoparasites reside on the host's outer surface, whereas endoparasites inhabit internal host tissues. Parasites rarely kill their hosts immediately, as sustaining the host's life ensures a continued long-term nutrient supply for the parasite.

156. (B) Kilocalories
In daily human nutrition, the term "Calorie" capitalized with a capital C refers specifically to a dietary Calorie, which is scientifically equivalent to one kilocalorie. One kilocalorie equals 1,000 standard thermodynamic gram calories, representing the heat energy needed to raise the temperature of one kilogram of water by one degree Celsius.

157. (B) Pitcher plant
The pitcher plant is an insectivorous plant adapted to grow in nitrogen-deficient soils, such as bogs. While performing photosynthesis to synthesize carbohydrates, it uses specialized pitcher-shaped leaf traps to capture and digest insects, absorbing dissolved nitrogen compounds from prey to fulfill its essential mineral requirements.

158. (B) To store and ferment chewed food with bacteria
The rumen serves as the first and largest stomach chamber in ruminant herbivores. Its primary function is to store swallowed plant material and maintain a specialized anaerobic fermentation vat. Symbiotic bacteria, protozoa, and fungi inside the rumen break down complex plant cell walls containing cellulose into digestible short-chain fatty acids.

159. (C) It eliminates fats entirely to prevent obesity.
A balanced diet does not eliminate fats entirely, as dietary fats are essential for absorbing fat-soluble vitamins, insulating tissues, synthesising cellular membranes, and producing vital hormones. Rather, a balanced diet includes appropriate proportional amounts of carbohydrates, proteins, healthy fats, vitamins, minerals, roughage, and water tailored to individual needs.

160. (D) Assertion (A) is false but Reason (R) is true.
Digestion of carbohydrates, not proteins, begins in the oral cavity through salivary amylase, which hydrolyzes dietary starch into disaccharides like maltose. Saliva contains no protein-digesting enzymes, so protein breakdown starts later in the acidic stomach. Consequently, the assertion is false while the description of amylase breaking down complex starch is true.

161. (B) Vitamin K
Vitamin K, or phylloquinone, is an essential fat-soluble cofactor required by the liver to synthesize essential blood coagulation factors, including prothrombin and Factors VII, IX, and X. A deficiency in Vitamin K impairs the enzymatic blood clotting cascade, resulting in prolonged bleeding times and delayed clot formation following injuries.

162. (C) Guard cells
Guard cells are specialized, paired epidermal cells that flank each stomatal pore in leaf surfaces. By altering their internal turgor pressure through osmotic movement of water, guard cells swell to open the stomatal aperture during daylight gas exchange or shrink to close the pore, thereby controlling stomatal size and transpiration rates.

163. (A) Primary consumer
In ecological food chains, an animal that feeds exclusively on autotrophic green plants or producers is classified as a herbivore and occupies the second trophic level as a primary consumer. Primary consumers transfer energy locked within plant tissue to higher trophic levels, serving as food for carnivorous secondary consumers.

164. (B) Cardiac sphincter
The cardiac sphincter, or lower oesophageal sphincter, is a ring of smooth muscle located at the junction between the distal oesophagus and the proximal stomach. It remains tonically contracted to prevent acidic gastric contents from flowing backward into the oesophagus, opening temporarily to allow swallowed food boluses to enter the stomach.

165. (C) Small Intestine
The complete chemical digestion of carbohydrates, proteins, and lipids is finalized within the small intestine, specifically inside the ileum. Here, digestive enzymes from pancreatic juice and intestinal succus entericus hydrolyze intermediate nutrients into absorbable simple monomers: monosaccharides, amino acids, fatty acids, and glycerol molecules.

166. (C) Carbohydrates
Carbohydrates constitute the major proportion of a plant's dry biomass. Green plants synthesize simple carbohydrates like glucose during photosynthesis using sunlight, water, and atmospheric carbon dioxide. These carbohydrates are subsequently polymerized into structural cellulose for cell walls and storage starch reserves, forming the main chemical constituent of plant tissues.

167. (B) A symbiotic algal-fungal association
Lichens represent an obligate mutualistic symbiotic association between a photosynthetic photobiont, usually a green alga or cyanobacterium, and a heterotrophic mycobiont fungus. The algal partner performs photosynthesis to synthesize organic nutrients, while the fungal partner forms

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a protective thallus structure, absorbs minerals, and retains moisture for the partnership.

168. (B) Regurgitated, partially digested plant matter
In ruminant herbivores, "cud" refers to a bolus of swallowed, partially fermented plant material regurgitated from the rumen back into the mouth cavity. Ruminants chew the cud thoroughly during periods of rest, mechanically grinding plant fibers to increase surface area for enhanced microbial enzymatic breakdown of structural cellulose inside the stomach.

169. (B) It regulates stomatal opening and closing.
Potassium is an essential inorganic nutrient in plant physiology that acts as a primary osmotic regulator. Active accumulation of potassium ions inside guard cells lowers osmotic potential, causing water influx that swells guard cells and opens stomatal pores. Conversely, potassium efflux causes guard cell turgor loss, closing stomata to conserve water.

170. (D) Spleen
Accessory digestive glands secrete chemical juices into the alimentary canal to facilitate food breakdown; these include salivary glands, the liver, and the pancreas. The spleen is not an accessory digestive gland; it belongs to the lymphatic and circulatory systems, functioning in red blood cell filtration, iron recycling, and immune surveillance.

171. (B) Ingestion
Ingestion in Amoeba requires the presence of external prey or organic food particles to trigger pseudopodial extension around the target. If placed in a sterile environment completely devoid of food particles, the organism lacks chemical stimuli to initiate phagocytosis, causing the process of food ingestion to halt immediately.

172. (B) Peristalsis
Peristalsis is the coordinated sequence of wave-like smooth muscle contractions and relaxations moving along the alimentary canal. Controlled by the enteric nervous system, peristaltic waves continuously push swallowed food boluses, gastric chyme, and indigestible waste forward through the oesophagus, stomach, small intestine, and large intestine during digestion.

173. (C) I, III and IV
Vitamins are organic micronutrients essential for immune protection, metabolic regulation, and health; they yield no energy and are required in tiny trace amounts daily, not large quantities. Heat-sensitive Vitamin C is easily degraded by prolonged cooking. Therefore, statements I, III, and IV are correct, while statement II is incorrect.

174. (C) Carbohydrates
Carbohydrates are primary energy-yielding macronutrients that undergo enzymatic catabolism and cellular oxidation to generate ATP. In contrast, micronutrients like Vitamin C and iron, alongside indigestible dietary fibre, do not yield metabolic calories or ATP; rather, they regulate biochemical reactions, support oxygen transport, and assist bowel transit.

175. (B) Maximizing surface area for absorption
The presence of circular mucosal folds, finger-like villi, and microscopic microvilli within the human small intestine represents an evolutionary adaptation to expand internal absorptive surface area significantly. This structural expansion optimizes the efficiency and rate of passive and active transport of digested nutrient monomers across intestinal mucosa into systemic circulation.

176. (B) Kwashiorkor
Kwashiorkor is a form of severe protein-energy malnutrition occurring in children whose dietary intake provides sufficient total carbohydrate calories but lacks adequate essential proteins. Lacking amino acids for plasma protein synthesis, osmotic imbalance causes fluid accumulation, resulting in peripheral edema, swollen belly, liver enlargement, hair discoloration, and tissue wasting.

177. (A) I, II, III, IV
Plant photosynthetic structure follows a hierarchical structural organization from microscopic molecular components to macroscopic organs. Chlorophyll molecules are embedded within thylakoid membranes inside the chloroplast organelle. Chloroplasts reside within eukaryotic mesophyll cells, which collectively constitute internal photosynthetic tissues of the broad leaf organ.

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178. (B) It increases to a limit.
Carbon dioxide serves as an essential reactant in dark reactions of photosynthesis. Increasing carbon dioxide concentration under optimal temperature and light availability enhances

RuBisCO enzymatic carbon fixation, accelerating the photosynthetic rate. However, the rate eventually plateaus at a maximum limit when enzymes become saturated or another factor becomes limiting.

179. (B) Vitamin D and Calcium
Calcium provides the primary mineral structural matrix for bone density, while Vitamin D is necessary for intestinal absorption of dietary calcium. A combined deficiency in Vitamin D and calcium impairs bone mineralization, leading to reduced bone density, bone softening, structural weakness, skeletal pain, and heightened susceptibility to fractures.

180. (B) Transpiration
Transpiration is the physiological process where water evaporates from moist internal mesophyll surfaces and exits as water vapour through open leaf stomatal pores into the atmosphere. Transpiration creates a negative pressure tension known as transpiration pull, driving upward transport of water and dissolved minerals from roots through xylem vessels.

181. (C) Both physical and chemical
Human digestion involves both physical and chemical mechanisms working in tandem. Physical digestion includes mechanical mastication in the mouth, churning within the stomach, and lipid emulsification by bile salts to break food into smaller particles. Chemical digestion utilizes hydrolytic enzymes to cleave complex chemical bonds, converting macromolecules into absorbable monomers.

182. (D) Large intestine
The large intestine is specialized for absorbing water and dissolved electrolytes from undigested food residue entering from the ileum. As indigestible chyme passes through the colon, mucosal epithelial cells reabsorb the majority of remaining water, transforming fluid waste into consolidated semi-solid feces for temporary rectal storage.

183. (C) Amylase
Pepsin, trypsin, and peptidase are all proteolytic digestive enzymes specifically adapted to hydrolyze peptide bonds in proteins, converting them into smaller peptides and amino acids. Conversely, amylase is a glycoside hydrolase enzyme that acts exclusively on carbohydrate polymers, hydrolyzing complex starches into disaccharide sugars like maltose.

184. (B) Increasing surface area of fat droplets
Bile salts possess amphipathic chemical properties that allow them to emulsify large, insoluble dietary lipid masses into microscopic emulsion droplets in the small intestine. This physical dispersion tremendously increases the accessible surface area of fats, enabling water-soluble pancreatic lipase enzymes to hydrolyze lipid molecules efficiently into fatty acids and glycerol.

185. (A) P-2, Q-3, R-4, S-1
Organisms exhibit distinct nutritional modes depending on food sources. Herbivores feed exclusively on living plant vegetation, carnivores consume animal tissue, and omnivores ingest both plant and animal matter. Saprophytes obtain nutrients by secreting enzymes to decompose dead organic substrates like rotting wood and fallen leaves.

186. (B) Vitamin B_1
Vitamin B_1, or thiamine, is an essential water-soluble vitamin that serves as a vital coenzyme in carbohydrate metabolism and neural energy production. A severe dietary deficiency in thiamine causes beriberi, a metabolic disorder characterized by peripheral neuropathy, muscle weakness, loss of coordination, cardiovascular enlargement, and systemic edema.

187. (B) Incisors, Canines, Premolars, Molars
Human dentition exhibits a specific spatial arrangement from the midline to the posterior jaw. Moving from front to back, each jaw quadrant features chisel-shaped incisors for cutting, a pointed canine for tearing, flattened premolars for crushing, and broad multi-cusped molars for grinding swallowed food particles.

188. (C) Saprophyte
Bread mould, or Rhizopus, is a multicellular fungus that exhibits saprophytic nutrition. Lacking chlorophyll pigments, it cannot synthesize organic nutrients through photosynthesis. Instead, Rhizopus extends microscopic hyphal threads over decaying organic substrates like damp bread, secreting extracellular digestive enzymes to breakdown complex starches and absorbing simple dissolved nutrients.

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189. (C) Light energy to chemical energy
Photosynthesis is a fundamental bioenergetic process where photosynthetic pigments like chlorophyll absorb radiant light energy from solar radiation. During light-dependent reactions within thylakoid membranes, this light energy is converted into chemical energy stored in ATP and NADPH, which subsequently drives organic sugar synthesis during dark reactions.

190. (B) To test for the presence of starch
In photosynthesis experiments, leaves are boiled in alcohol to extract chlorophyll pigments, decolorizing the leaf tissue. Subsequent application of iodine solution tests for starch synthesized during photosynthesis. Iodine molecules react with helical amylose chains in starch, forming a characteristic dark blue-black complex that confirms photosynthetic starch storage.

191. (B) Water
Water is a small, inorganic polar molecule that does not require enzymatic digestion before absorption. Unlike complex organic polymers like carbohydrates, proteins, and fats that must undergo hydrolytic cleavage into simpler monomers, water is absorbed directly across epithelial cell membranes throughout the stomach and intestines via osmosis.

192. (C) I and III only
Water is vital for human physiology, serving as a universal solvent for biochemical reactions and helping regulate body temperature through perspiration. Water is inorganic and yields no caloric energy when processed. Thus, statements I and III accurately describe water's role, while statement II is scientifically incorrect.

193. (B) Microvilli
Microvilli are microscopic, finger-like plasma membrane extensions projecting from the apical surface of simple columnar epithelial cells lining small intestine villi. Formally termed the brush border, microvilli tremendously expand the internal cellular surface area available for membrane transport proteins and hydrolytic enzymes involved in terminal nutrient absorption.

194. (B) Nitrogen
Nitrogen is an essential mineral nutrient required by plants for protein synthesis. Amino acids, the chemical building blocks of proteins, contain amino functional groups composed of nitrogen atoms bound to hydrogen. Plants absorb soil nitrogen as nitrates or ammonium, incorporating it into amino acid pathways to synthesize structural proteins and functional enzymes.

195. (A) Rickets
Rickets is a nutritional deficiency disease in growing children caused by insufficient Vitamin D, calcium, or phosphate. Deficiency impairs bone matrix mineralization, leaving developing bones soft and pliable. Clinical manifestations include bowed legs, pigeon chest deformities, enlarged wrist joints, delayed fontanelle closure, and skeletal bone pain.

196. (A) Ingestion
Ingestion is the initial physiological phase of animal nutrition, defined as taking food or liquid into the body through the mouth or specialized cellular structures. Ingestion allows organisms to capture external organic material, moving it into an internal digestive tract or cellular food vacuole where mechanical and chemical digestion proceed.

197. (A) Both participating organisms benefit.
Symbiotic nutrition, specifically mutualism, is an ecological relationship where two distinct species live in close physical proximity and both derive metabolic benefits. Examples include nitrogen-fixing Rhizobium bacteria in leguminous root nodules and algal-fungal partnerships in lichens, where nutrient exchange enhances survival for both participating organisms.

198. (B) I, III and IV
A balanced diet provides proper proportions of essential nutrients, supplying required energy for daily physical activities, promoting tissue repair, supporting physical growth, and boosting immunity against diseases. Achieving nutritional balance relies on dietary variety rather than expensive or exotic foods; therefore, statements I, III, and IV are correct.

199. (B) Digested insects
Carnivorous plants like the Venus flytrap inhabit acidic, waterlogged soils that are severely deficient in available soil nitrates. To fulfill their nitrogen requirements for protein synthesis, these plants trap insects using modified leaves and secrete digestive enzymes that hydrolyze

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insect tissues, absorbing dissolved nitrogenous compounds directly into plant cells.

200. (A) Heterotrophs cannot synthesize organic food from inorganic carbon.
Heterotrophic organisms lack photosynthetic pigments like chlorophyll and cannot fix inorganic carbon dioxide into organic carbohydrates using solar energy. Consequently, heterotrophs depend on autotrophs directly by eating plant tissue or indirectly by consuming herbivorous animals to obtain preformed organic molecules essential for cellular respiration and survival.

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CHAPTER 02
Respiration

1. The biological process in which food is oxidized to release energy for cellular activities is defined as
(A) Photosynthesis
(B) Respiration
(C) Assimilation
(D) Transpiration

2. Which of the following differentiates aerobic respiration from anaerobic respiration?
(A) Aerobic respiration produces lactic acid in animal tissues
(B) Anaerobic respiration occurs exclusively in plant cells
(C) Anaerobic respiration produces far more ATP per glucose
(D) Aerobic respiration requires free molecular oxygen

3. What is the end product of glycolysis during cellular respiration?
(A) Pyruvate
(B) Glucose
(C) Lactic acid
(D) Ethanol

4. In which cellular organelle does the Krebs cycle primarily take place?
(A) Ribosomal complex
(B) Cytoplasmic fluid
(C) Mitochondria
(D) Cell nucleus

5. Which of the following correctly represents the sequence of air passage in the human respiratory system?
(A) Nostrils, Pharynx, Larynx, Trachea, Alveoli
(B) Larynx, Nostrils, Pharynx, Trachea, Alveoli
(C) Trachea, Pharynx, Larynx, Nostrils, Alveoli
(D) Nostrils, Trachea, Larynx, Pharynx, Alveoli

6. The exchange of gases in the leaves of plants primarily takes place through
(A) Lenticels
(B) Root hairs
(C) Hydathodes
(D) Stomata

7. Which of the following respiratory diseases is often caused by an allergic reaction causing inflammation and narrowing of the airways?
(A) Tuberculosis
(B) Asthma
(C) Pneumonia
(D) Emphysema

8. The term oxygen debt refers to the extra oxygen required by the body after heavy exercise to break down accumulated
(A) Glucose
(B) Pyruvic acid
(C) Lactic acid
(D) Glycogen

9. Why is the mitochondrion commonly referred to as the powerhouse of the cell?
(A) It controls and regulates all major cellular activities
(B) It directly absorbs solar energy for glucose synthesis
(C) It synthesizes structural proteins required for cell growth
(D) It produces ATP during cellular respiration

10. Given below are two statements, one labeled as Assertion (A) and the other labeled as Reason (R).
Assertion (A): The rings of cartilage in the trachea ensure that the air passage does not collapse.
Reason (R): Cartilage provides a rigid yet flexible structural support to the tracheal wall.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

11. Which molecule is widely known as the energy currency of the cell?
(A) DNA
(B) ATP
(C) RNA

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(D) ADP

12. Gaseous exchange in fish occurs mainly through which specialized organs?
(A) Spiracles
(B) Gills
(C) Lungs
(D) Skin

13. During human inhalation, what is the primary movement of the diaphragm?
(A) It contracts and flattens
(B) It relaxes and curves upward
(C) It expands laterally
(D) It remains stationary

14. Which statement is correct regarding alcoholic fermentation in yeast?
(A) It requires an abundant supply of atmospheric oxygen
(B) It produces large amounts of lactic acid and water
(C) It yields ethanol, CO_2, and energy
(D) It takes place exclusively within the mitochondria

15. Consider the following statements about respiration:
I. It is an energy-releasing process.
II. It occurs both during the day and night in plants.
III. It is identical to the process of combustion.
Which of the above statements is/are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II, and III

16. In humans, the respiratory pigment that binds with oxygen and transports it to various tissues is
(A) Chlorophyll
(B) Melanin
(C) Haemoglobin
(D) Carotene

17. The process of respiration in insects like cockroaches occurs directly through a network of tubes called the
(A) Vascular system
(B) Tracheal system
(C) Alveolar system
(D) Bronchial system

18. At high altitudes, human breathing rate increases primarily because
(A) The air is too cold
(B) Carbon dioxide levels are excessively high
(C) The body requires less energy
(D) The partial pressure of oxygen is lower

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19. Which structure prevents food from entering the trachea during swallowing?
(A) Epiglottis
(B) Larynx tissue
(C) Pharynx region
(D) Bronchus tube

20. Match the organisms in List I with their primary respiratory structures in List II and select the correct option.
List I: Organism
P. Fish
Q. Earthworm
R. Insect
S. Human
List II: Respiratory structure
1. Trachea
2. Lungs
3. Gills
4. Moist skin
(A) P-3, Q-4, R-1, S-2
(B) P-4, Q-3, R-2, S-1
(C) P-3, Q-1, R-4, S-2
(D) P-2, Q-4, R-1, S-3

21. What is the maximum volume of air a person can exhale after a maximum inhalation called?
(A) Vital capacity
(B) Tidal volume
(C) Residual volume
(D) Inspiratory capacity

22. In plants, the exchange of gases in the woody stems takes place through small pores known as
(A) Stomata
(B) Epidermis
(C) Trichomes
(D) Lenticels

23. During intense physical exercise, cramps may occur in muscle cells due to the accumulation of
(A) Carbon dioxide
(B) Lactic acid
(C) Alcohol
(D) Water

24. Which of the following is a harmful effect of smoking on the respiratory system?

(A) Increased elasticity and flexibility of the alveoli
(B) Enhanced oxygen transport capacity by haemoglobin
(C) Destruction of respiratory cilia
(D) Dilation and enlargement of the bronchioles

25. Consider the following statements about alveoli:
I. They are balloon-like structures in the lungs.
II. They provide a very large surface area for gas exchange.
III. Their walls contain an extensive network of blood vessels.
IV. They are supported by thick cartilaginous rings.
Which of the above statements is/are correct?
(A) I, II, and III
(B) II, III, and IV
(C) I, III, and IV
(D) I, II, and IV

26. The chemical equation for aerobic respiration involves the breakdown of glucose to yield
(A) Carbon dioxide, water, and energy
(B) Lactic acid, carbon dioxide, and energy
(C) Ethanol, water, and energy
(D) Pyruvate, oxygen, and energy

27. The first stage of cellular respiration, glycolysis, occurs in the
(A) Nucleus
(B) Cytoplasm
(C) Mitochondria
(D) Chloroplast

28. Which of the following distinguishes cellular respiration from burning (combustion)?
(A) Respiration produces heat and light energy in a single sudden burst
(B) Respiration is an enzyme-controlled process
(C) Combustion produces large amounts of cellular ATP molecules
(D) Combustion occurs continuously inside living biological cells

29. What happens to the volume of the thoracic cavity during human exhalation?
(A) It decreases
(B) It increases
(C) It remains unchanged
(D) It fluctuates rapidly

30. Carbon dioxide is transported in human blood primarily in the form of
(A) Carboxyhaemoglobin
(B) Free carbon dioxide gas in red blood cells
(C) Dissolved bicarbonate ions in plasma
(D) Carbonic acid in white blood cells

31. Plant roots require oxygen for respiration. In waterlogged soils, plants may die because
(A) Roots absorb an excess toxic level of dissolved oxygen
(B) Excess water causes extreme chemical root burning and decay
(C) Soil temperature becomes too high for cell survival
(D) Soil air spaces are cleared of oxygen

32. Which part of the human respiratory system is commonly known as the voice box?
(A) Trachea
(B) Pharynx
(C) Larynx
(D) Bronchiole

33. In the daytime, the net gaseous exchange in plant leaves is characterized by
(A) Release of carbon dioxide and uptake of oxygen
(B) Release of oxygen and uptake of carbon dioxide
(C) Release of nitrogen and uptake of oxygen
(D) No exchange of gases

34. Bronchitis is a respiratory disease characterized primarily by the inflammation of the
(A) Nasal cavity and passages
(B) Alveolar sacs in lungs
(C) Diaphragm muscle wall
(D) Bronchi

35. Arrange the following events of human respiration in the correct physiological order:
1. Diffusion of oxygen into blood
2. Cellular respiration in tissues
3. Air enters the alveoli
4. Transport of oxygen by haemoglobin
(A) 3, 1, 4, 2
(B) 1, 3, 2, 4
(C) 3, 4, 1, 2
(D) 4, 1, 3, 2

36. Which cellular process establishes a direct link between nutrition and respiration?
(A) Excretion of urea through the urinary system
(B) Absorption of solar light energy by plant chlorophyll
(C) Oxidation of glucose to yield ATP
(D) Secretion of digestive enzymes into the

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alimentary canal

37. The total net yield of ATP from the complete aerobic breakdown of one glucose molecule is
(A) 2 ATP
(B) 8 ATP
(C) 38 ATP
(D) 100 ATP

38. In an anaerobic environment, yeast breaks down glucose to produce
(A) Lactic acid and pure water
(B) Ethanol and CO_2
(C) Citric acid and liquid ethanol
(D) Glucose and elemental oxygen

39. The process by which oxygen enters the blood from the alveoli and carbon dioxide exits the blood into the alveoli is known as
(A) Active transport
(B) Osmosis
(C) Diffusion
(D) Filtration

40. Given below are two statements, one labeled as Assertion (A) and the other labeled as Reason (R).
Assertion (A): The breathing rate of aquatic animals is much faster than that of terrestrial animals.
Reason (R): The amount of dissolved oxygen in water is fairly low compared to the amount of oxygen in the air.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

41. Haemoglobin shows maximum chemical affinity for which of the following gases, often leading to fatal poisoning?
(A) Pure molecular oxygen
(B) Carbon dioxide gas
(C) Carbon monoxide
(D) Elemental nitrogen

42. Which physical factor primarily determines the rate of respiration in an individual?
(A) Hair color and skin pigmentation patterns
(B) Physical activity levels
(C) Amount of water ingested during meals
(D) Rate of hair growth and fingernail extension

43. Stomata are surrounded by specialized cells that regulate their opening and closing. These cells are called
(A) Epidermal cells
(B) Mesophyll cells
(C) Companion cells
(D) Guard cells

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44. When you blow air from your mouth into a test tube containing lime water, it turns milky. This proves that exhaled air contains
(A) Carbon dioxide
(B) Molecular oxygen gas
(C) Atmospheric nitrogen
(D) Water vapor droplets

45. Consider the following statements about the diaphragm:
I. It is a muscular sheet located below the lungs.
II. It separates the thoracic cavity from the abdominal cavity.
III. It remains perfectly flat during exhalation.
Which of the above statements is/are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II, and III

46. The structural and functional units of the lungs where actual gas exchange takes place are the
(A) Bronchi
(B) Bronchioles
(C) Alveoli
(D) Trachea

47. Anaerobic respiration in human muscle cells yields a net gain of how many ATP molecules per glucose molecule?
(A) 2
(B) 12
(C) 36
(D) 38

48. Smoking tobacco delivers a harmful sticky substance into the lungs that paralyzes cilia and damages alveoli. This substance is
(A) Nicotine
(B) Menthol
(C) Butane
(D) Tar

49. The process of extracting energy from food without the use of oxygen is called
(A) Aerobic respiration

(B) Fermentation
(C) Transpiration
(D) Photosynthesis

50. During resting state, how do plants mainly excrete the carbon dioxide produced by cellular respiration?
(A) Through the roots directly into the surrounding soil
(B) By release through stomata
(C) By converting it chemically into solid waste matter
(D) By dissolving it in cell sap on a permanent basis

51. Which of the following defines vital capacity accurately?
(A) Max air exhaled after deepest inhalation
(B) The normal standard amount of air inhaled during a routine breath
(C) The volume of air remaining in lungs after a complete exhalation
(D) The average overall rate of human breathing calculated per minute

52. The breakdown of a 6-carbon glucose molecule into two 3-carbon pyruvate molecules is an essential step in
(A) Aerobic respiration only
(B) Both aerobic and anaerobic respiration
(C) Anaerobic respiration only
(D) Photosynthesis

53. The inner membrane of mitochondria is deeply folded. What is the primary function of these folds?
(A) To store large reserve amounts of cellular glucose
(B) To trap incoming solar sunlight for photosynthesis
(C) To increase surface area for ATP synthesis
(D) To produce complex catalytic enzymes for cell digestion

54. What gives oxygenated blood its bright red color?
(A) Plasma
(B) White blood cells
(C) Platelets
(D) Oxyhaemoglobin

55. Which of the following represents the correct sequence of events during inhalation?
(A) Ribs move down → Diaphragm relaxes → Chest cavity shrinks
(B) Ribs move up and out → Diaphragm contracts → Chest cavity expands
(C) Diaphragm relaxes → Ribs move up → Chest cavity expands
(D) Chest cavity expands → Diaphragm relaxes → Ribs move down

56. The gills of a fish are highly efficient at extracting oxygen from water because they
(A) Are located on the outside of the body without any protective cover
(B) Are rich in blood vessels with large surface area
(C) Can store exceptionally large reserve amounts of atmospheric air
(D) Work using mechanisms identical to mammalian pulmonary lungs

57. Which respiratory disease is specifically characterized by the breakdown of alveolar walls, greatly reducing the surface area for gas exchange, and is highly linked to smoking?
(A) Cholera
(B) Asthma
(C) Diphtheria
(D) Emphysema

58. How do insect spiracles function in respiration?
(A) They act as small internal pulmonary lungs for gas exchange
(B) Body surface pores opening into tracheal tubes
(C) They pump hemolymph blood to directly transport gas oxygen
(D) They absorb dissolved molecular oxygen from surrounding water

59. At night, why is it generally advised not to sleep under a large tree?
(A) Trees release excess oxygen gas at night which is toxic to human lungs
(B) Trees absorb all the surrounding oxygen preventing human breathing
(C) The tree leaves continuously drop harmful volatile chemicals at night
(D) Trees release CO_2 at night due to respiration

60. Match the respiratory terms in List I with their functions/descriptions in List II.
List I: Respiratory term
P. Alveoli
Q. Larynx
R. Diaphragm
S. Haemoglobin

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List II: Function/description
1. Gas transport
2. Site of gas exchange
3. Voice production
4. Muscle for breathing

(A) P-2, Q-3, R-4, S-1
(B) P-1, Q-2, R-3, S-4
(C) P-4, Q-1, R-2, S-3
(D) P-3, Q-4, R-1, S-2

61. In aerobic respiration, the complete oxidation of pyruvate takes place in the
(A) Cytoplasm
(B) Ribosome
(C) Mitochondria
(D) Endoplasmic reticulum

62. Which of the following is considered an intermediate product common to both aerobic and anaerobic breakdown of glucose?
(A) Ethanol
(B) Lactic acid
(C) Pyruvate
(D) Citric acid

63. ATP stands for
(A) Adenosine Triphosphate
(B) Adenine Tetraphosphate
(C) Adenosine Diphosphate
(D) Ammonium Triphosphate

64. A person experiencing a sudden drop in atmospheric pressure at high altitude may suffer from hypoxia. This condition is a result of
(A) Lack of sufficient carbon dioxide in the blood
(B) Insufficient oxygen reaching the body tissues
(C) Excess nitrogen absorption
(D) Dehydration of the lungs

65. Consider the following statements about plant respiration:
I. Plants respire constantly, both day and night.
II. Roots absorb oxygen from air trapped between soil particles.
III. Leaves possess lenticels for major gas exchange.
IV. The rate of respiration in plants is much slower than in animals.

Which of the above statements is/are correct?
(A) I, II, and IV
(B) I, II, and III
(C) II, III, and IV
(D) I, III, and IV

66. The cartilage rings are present in the human respiratory tract in the
(A) Bronchioles and respiratory alveoli
(B) Trachea and bronchi
(C) Pharynx area and the epiglottis
(D) Nasal cavity passages exclusively

67. The phenomenon of oxygen debt is finally resolved when
(A) Lactic acid is fully oxidized to CO_2 and water
(B) Glucose is converted directly into ethyl alcohol in muscle tissue
(C) Heart rate drops significantly below the normal resting baseline
(D) Muscle cells burst due to severe chemical strain and stress

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68. The primary function of the nasal cavity during inhalation is to
(A) Produce vocal acoustic sounds for speech
(B) Warm, moisten, and filter air
(C) Absorb oxygen directly into the brain tissue
(D) Expel carbon dioxide gas forcefully from lungs

69. Respiration is a continuous biological process whereas combustion is
(A) A slow, highly regulated enzyme-driven biological process
(B) A rapid, uncontrolled reaction
(C) A cellular process that generates abundant ATP molecules
(D) A biological process strictly requiring intact living cells

70. Given below are two statements, one labeled as Assertion (A) and the other labeled as Reason (R).
Assertion (A): Aerobic respiration produces much more energy than anaerobic respiration.
Reason (R): Aerobic respiration involves the complete breakdown of glucose into carbon dioxide and water.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

71. The condition in which bronchi narrow and swell, often producing extra mucus and making breathing difficult, is called

(A) Tuberculosis
(B) Asthma
(C) Lung cancer
(D) Pleurisy

72. Which of the following gas is virtually unreactive during human respiration and is exhaled in the same quantity as it is inhaled?
(A) Oxygen
(B) Carbon dioxide
(C) Nitrogen
(D) Water vapor

73. Which chemical is often used in laboratories to absorb carbon dioxide and prove its production during seed respiration?
(A) Hydrochloric acid solution
(B) Sodium chloride compound
(C) Potassium hydroxide
(D) Copper sulphate crystals

74. The conversion of ATP to ADP releases energy because
(A) A phosphate bond is broken
(B) Glucose is formed
(C) Oxygen is absorbed
(D) Carbon dioxide is synthesized

75. Arrange the following parts of the human respiratory tract in order from the site of gas exchange backwards to the outside:
1. Trachea
2. Alveoli
3. Pharynx
4. Bronchioles

(A) 2, 4, 1, 3
(B) 2, 1, 4, 3
(C) 3, 1, 4, 2
(D) 4, 2, 1, 3

76. Fermentation of dough used for making bread causes it to rise due to the release of
(A) Concentrated ethanol vapor
(B) Molecular oxygen gas
(C) Carbon dioxide
(D) Concentrated lactic acid

77. The bony structures that protect the lungs and move during the breathing process are the
(A) Clavicles
(B) Ribs
(C) Scapulae
(D) Sternum only

78. In human blood, oxygen is transported mainly by
(A) Plasma
(B) White blood cells
(C) Red blood cells
(D) Platelets

79. When an athlete runs a sprint, why do their muscles sometimes switch to anaerobic respiration?
(A) Because skeletal muscles always prefer lactic acid over glucose fuel
(B) Oxygen supply cannot meet high energy demand
(C) Because anaerobic cellular respiration yields significantly more energy
(D) Because blood carbon dioxide levels drop excessively too low in muscles

80. The Krebs cycle is also commonly known as the
(A) Calvin cycle
(B) Glycolysis pathway
(C) Citric acid cycle
(D) Lactic acid cycle

81. In an experiment to demonstrate respiration in plants, germinating seeds are preferred over dry seeds because
(A) Germinating seeds respire faster
(B) Germinating seeds actively undergo light photosynthesis
(C) Dry seeds strictly respire anaerobically in all conditions
(D) Dry seeds completely lack and do not contain any glucose fuel

82. Which of the following is the odd one out regarding the human respiratory system?
(A) Trachea tube
(B) Bronchus passageway
(C) Esophagus
(D) Respiratory alveoli

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83. The tiny hair-like structures in the human nasal passage that trap dust particles are called
(A) Microvilli
(B) Cilia
(C) Flagella
(D) Trichomes

84. Which statement is correct regarding the respiratory surface of organisms?
(A) It should be structurally thick, completely dry, and tough
(B) It should possess a minimal and small total

surface area
(C) Thin, moist, with large surface area
(D) It does not require any direct blood capillary supply in higher animals

85. Consider the following statements about haemoglobin:
I. It is an iron-containing protein.
II. It has a high affinity for oxygen.
III. It is found in the plasma of blood.
Which of the above statements is/are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II, and III

86. How does respiration contribute to the body temperature of warm-blooded animals?
(A) By absorbing large amounts of heat directly from the surrounding environment
(B) By releasing heat during cellular oxidation
(C) By cooling down the physical body through continuous evaporation in lungs
(D) Respiration has absolutely no direct physiological effect on body temperature

87. A person lives at a high altitude for a prolonged period. Which physiological adaptation is most likely to occur?
(A) Significant decrease in total lung volume
(B) Increase in red blood cell count
(C) Permanent decrease in resting heart rate
(D) Complete physiological switch to anaerobic respiration

88. The respiratory centre in the human brain primarily monitors the concentration of which gas in the blood to regulate breathing?
(A) Oxygen
(B) Nitrogen
(C) Carbon dioxide
(D) Carbon monoxide

89. Aquatic organisms like fishes draw water into their mouth and force it past the gills to
(A) Drink water
(B) Extract dissolved oxygen
(C) Release dissolved nutrients
(D) Regulate body temperature

90. Which structural feature of a leaf helps in minimizing water loss while allowing gas exchange?
(A) The internal cellular arrangement of photosynthetic chloroplasts
(B) Waxy cuticle and guard cells
(C) The overall physical size and thickness of the broad leaf blade
(D) The specific structural length and width of the supporting petiole

91. What is the approximate percentage of oxygen in the air we inhale?
(A) 78%
(B) 21%
(C) 16%
(D) 4%

92. What is the approximate percentage of oxygen in the air we exhale?
(A) 21%
(B) 16%
(C) 4%
(D) 0%

93. A spirometer is a medical device used directly to measure
(A) Systemic arterial blood pressure levels
(B) Average resting heart rate per minute
(C) Lung volumes and capacity
(D) Dissolved oxygen concentration in arterial blood

94. The breakdown of pyruvate using oxygen takes place in the
(A) Cytoplasmic fluid
(B) Mitochondria
(C) Chloroplast stroma
(D) Cell nucleus

95. What is the primary cause of oxygen debt in humans?
(A) Severe long-term lack of mineral iron in daily diet
(B) Continuous excessive rate of aerobic cellular respiration
(C) Oxygen deficit during exercise
(D) Prolonged environmental exposure to high mountain altitude

96. Which part of the respiratory system contains C-shaped rings of cartilage?
(A) Pharynx
(B) Trachea
(C) Alveoli
(D) Larynx

97. The process of taking air into the lungs is called
(A) Exhalation
(B) Inhalation

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(C) Excretion
(D) Digestion

98. Why do the walls of the trachea not collapse when there is less air in it?
(A) Due to the continuous presence of high local blood pressure
(B) Due to cartilaginous rings
(C) Due to ongoing strong involuntary muscular contractions
(D) Due to an uninterrupted continuous airflow coming from the nose

99. Which of the following is true about the transport of carbon dioxide in humans?
(A) It is primarily transported by binding directly to hemoglobin inside red blood cells
(B) It is soluble and mostly transported in plasma
(C) It requires active metabolic transport mechanisms using cellular ATP molecules
(D) It is transported strictly and exclusively throughout the bloodstream as carbonic acid gas

100. Match the disease/condition in List I with its primary cause/feature in List II.
List I: Disease/Condition
P. Emphysema
Q. Carbon monoxide poisoning
R. Asthma
S. Muscle cramps
List II: Primary cause/feature
1. Hypersensitivity/inflammation of bronchi
2. Damage to alveolar walls
3. Accumulation of lactic acid
4. Formation of carboxyhaemoglobin
(A) P-2, Q-4, R-1, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-4, Q-3, R-2, S-1
(D) P-2, Q-1, R-4, S-3

101. Which component of tobacco smoke is primarily responsible for reducing the oxygen-carrying capacity of blood?
(A) Sticky tobacco tar
(B) Nicotine alkaloid
(C) Carbon monoxide
(D) Hydrogen cyanide

102. Cellular respiration is considered a catabolic process because
(A) It continuously synthesizes and builds up complex structural molecules
(B) It breaks food down to release energy
(C) It strictly requires a constant direct input of radiant solar energy
(D) It is a metabolic pathway that occurs exclusively in complex animals

103. In terrestrial plants, stomata are generally found in greatest numbers on the
(A) Upper surface of the leaf
(B) Lower surface of the leaf
(C) Stems
(D) Roots

104. Which of the following best describes the role of the epiglottis?
(A) It acts as the principal organ that produces vocal acoustic sound
(B) It continuously filters incoming atmospheric air entering the lungs
(C) It prevents food entering the windpipe
(D) It connects the pharyngeal region directly to the upper nasal cavity

105. Consider the following statements about gill respiration in fishes:
I. Gills are protected by an operculum in many fishes.
II. Fish swallow water through the mouth and pass it over the gills.
III. Blood flows in gills in a direction opposite to water flow to maximize oxygen uptake.
IV. Fishes can breathe efficiently on land using their gills.
Which of the above statements is/are correct?
(A) I, II, and IV
(B) I, II, and III
(C) II, III, and IV
(D) I, III, and IV

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106. The volume of the thoracic cavity increases during inhalation. This leads to
(A) An increase in air pressure inside the lungs
(B) A decrease in air pressure inside the lungs
(C) No change in air pressure
(D) The expulsion of air from the lungs

107. Which of the following defines the pathway of air from the environment to the lungs?
(A) Nasal cavity, Larynx, Pharynx, Trachea, Bronchi
(B) Nasal cavity, Pharynx, Larynx, Trachea, Bronchi
(C) Pharynx, Nasal cavity, Larynx, Trachea, Bronchi

(D) Larynx, Nasal cavity, Pharynx, Trachea, Bronchi

108. The disease bronchitis primarily affects which part of the respiratory system?
(A) Pulmonary alveoli sacs
(B) Bronchial tubes
(C) Thoracic diaphragm muscle
(D) Larynx voice box

109. What is the role of mucus in the nasal cavity?
(A) To absorb oxygen
(B) To trap dust and foreign particles
(C) To digest food particles
(D) To increase the temperature of inhaled air to body temperature perfectly

110. Given below are two statements, one labeled as Assertion (A) and the other labeled as Reason (R).
Assertion (A): In plants, respiration occurs only at night.
Reason (R): Photosynthesis happens only during the day, so plants switch to respiration at night.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

111. Which form of respiration is utilized by yeast during the brewing of alcohol?
(A) Aerobic respiration
(B) Anaerobic respiration
(C) Photorespiration
(D) Cutaneous respiration

112. The energy released during cellular respiration is immediately used to synthesize
(A) DNA
(B) ATP
(C) Glucose
(D) Oxygen

113. A patient is advised to undergo physical therapy for lung volume expansion. Which function is directly being targeted?
(A) Digestion
(B) Vital capacity
(C) Heart rate
(D) Blood pressure

114. During exhalation, the ribs move
(A) Downwards and inwards
(B) Upwards and outwards
(C) Outwards and downwards
(D) Upwards and inwards

115. Which of the following pairs is correctly matched?
(A) Earthworm - Branchial Gills
(B) Cockroach - Spiracles
(C) Fish - Pulmonary Lungs
(D) Frog - Stem Lenticels

116. In humans, the right lung is divided into how many lobes?
(A) Two distinct lobes
(B) Three
(C) Four distinct lobes
(D) Five distinct lobes

117. Emphysema is a chronic respiratory disease. The most common cause of emphysema is
(A) Pollen allergy
(B) Viral infection
(C) Cigarette smoking
(D) Contaminated water

118. Which biological mechanism links the digestive system to the respiratory system?
(A) Digestion supplies glucose oxidized in respiration
(B) Digestion directly produces essential molecular oxygen required for cellular respiration
(C) Respiration directly produces organic food nutrients required for gastrointestinal digestion
(D) Both bodily systems share identical internal organ structures throughout the entire abdomen

119. A defining characteristic of aerobic respiration compared to anaerobic respiration is that it
(A) Produces less ATP
(B) Produces water as a byproduct
(C) Leaves organic waste like ethanol
(D) Occurs entirely in the cytoplasm

120. Which of the following is NOT a characteristic of a good respiratory surface?
(A) Exceptionally thin cellular walls
(B) Continuously moist internal surface
(C) Small surface area
(D) Richly vascularized capillary blood supply

121. What happens to the rate of respiration in a resting person compared to a person doing strenuous work?

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(A) It is higher
(B) It is lower
(C) It is exactly the same
(D) It stops completely

122. During daytime, the main gas released by plants into the atmosphere is
(A) Carbon dioxide
(B) Oxygen
(C) Nitrogen
(D) Carbon monoxide

123. The respiratory organs in adult frogs include
(A) Gills and lungs
(B) Lungs and moist skin
(C) Trachea and spiracles
(D) Moist skin and spiracles

124. The vocal cords are situated inside the
(A) Pharynx
(B) Trachea
(C) Larynx
(D) Bronchi

125. Consider the following statements regarding ATP:
I. It stores energy in its phosphate bonds.
II. It is produced only in animal cells.
III. It releases energy when broken down to ADP.
Which of the above statements is/are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II, and III

126. Which of the following is an incorrect statement about respiration?
(A) Energy is released in the form of ATP.
(B) Carbon dioxide and water are end products of aerobic respiration.
(C) Respiration occurs only in the cells of higher animals.
(D) Enzymes are required to catalyze respiratory reactions.

127. High altitude adaptation involves all of the following EXCEPT
(A) Increased red blood cell count
(B) Increased breathing rate
(C) Increased lung capacity over time
(D) Decreased heart rate

128. Why does the rate of breathing increase rapidly when running?
(A) To expel excessive amounts of oxygen gas from the circulating blood
(B) To meet increased oxygen demand
(C) To rapidly lower physical body temperature through hyperventilation
(D) To significantly decrease systemic arterial blood pressure levels

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129. During anaerobic respiration in yeast, the 3-carbon pyruvate is converted into
(A) Lactic acid molecule (3-carbon structure)
(B) Ethanol and carbon dioxide
(C) Glucose sugar molecule (6-carbon structure)
(D) Pure water molecules and molecular oxygen gas

130. The fine network of blood capillaries surrounding the alveoli is a part of the
(A) Central and peripheral nervous system
(B) Renal and urinary excretory system
(C) Circulatory system
(D) Gastrointestinal digestive system

131. Lenticels are involved in the exchange of gases in
(A) Soft green stems and leaves
(B) Old woody stems and roots
(C) Flowers only
(D) Seeds only

132. The process of taking in oxygen and giving out carbon dioxide through a respiratory organ is strictly called
(A) Cellular respiration pathway
(B) Breathing
(C) Internal tissue respiration
(D) Cytoplasmic glycolysis

133. Which of the following represents the correct chemical formula for glucose, the primary substrate for respiration?
(A) $C_6H_{12}O_6$
(B) $C_{12}H_{22}O_{11}$
(C) CH_4
(D) CO_2

134. Which group of organisms relies primarily on simple diffusion across the cell membrane for respiration?
(A) Complex mammals
(B) Avian species
(C) Amoeba
(D) Reptilian species

135. Which of the following options shows the correct order of energy yield (from lowest to highest) per molecule of glucose?
(A) Aerobic respiration → Anaerobic respiration in muscle → Fermentation in yeast
(B) Fermentation in yeast → Anaerobic respiration in muscle → Aerobic respiration
(C) Aerobic respiration → Fermentation in yeast → Anaerobic respiration in muscle
(D) Anaerobic respiration in muscle → Aerobic respiration → Fermentation in yeast

136. The term "pleura" refers to the
(A) Muscular sheet located directly below the thoracic lungs
(B) Membrane around lungs
(C) Structural C-shaped ring of cartilage in the tracheal wall
(D) Cartilaginous epiglottis flap covering the windpipe opening

137. Which of the following best explains why carbon monoxide is poisonous?
(A) It destroys internal pulmonary lung tissue and alveolar walls directly
(B) It binds haemoglobin tightly, causing hypoxia
(C) It causes immediate full cardiac arrest and circulatory failure
(D) It dissolves readily in blood plasma to form a highly destructive strong acid

138. The inner space of mitochondria contains a fluid-like substance where the Krebs cycle takes place, known as the
(A) Stroma
(B) Matrix
(C) Cytosol
(D) Plasma

139. In plants, the direction of diffusion of gases (oxygen and carbon dioxide) mainly depends upon
(A) Plant needs and environment
(B) Surrounding soil physical type and mineral composition
(C) Biological age of the plant species exclusively
(D) Seasonal presence or absence of reproductive flowers

140. A person suffering from asthma has difficulty breathing out primarily because
(A) The muscular diaphragm becomes completely paralyzed
(B) Airways narrow from inflammation
(C) The respiratory alveoli sacs have completely collapsed
(D) Blood haemoglobin concentration levels drop far too low

141. The exchange of gases between the blood and tissue cells is known as
(A) External respiration
(B) Internal respiration
(C) Pulmonary ventilation
(D) Cellular respiration

142. At rest, the normal human breathing rate is approximately
(A) 72-80 breaths per minute
(B) 12-20 breaths per minute
(C) 40-50 breaths per minute
(D) 5-8 breaths per minute

143. During an intense sprint, the lack of sufficient oxygen in muscles leads to the formation of lactic acid. This process is called
(A) Aerobic enzymatic glycolysis
(B) Anaerobic respiration
(C) Photosynthetic photolysis
(D) Mitochondrial Krebs cycle

144. Which of the following conditions is a primary risk factor for developing chronic bronchitis?
(A) Consuming a high-sugar daily diet
(B) Tobacco smoking
(C) Complete lack of physical exercise
(D) Chronic vitamin C dietary deficiency

145. Consider the following statements about respiration in humans:
I. The diaphragm contracts during inhalation.
II. Gaseous exchange occurs in the bronchi.
III. Oxygen binds to haemoglobin to form oxyhaemoglobin.
IV. Exhalation is accompanied by a decrease in thoracic volume.
Which of the above statements is/are correct?
(A) I, II, and III
(B) I, III, and IV
(C) II, III, and IV
(D) I, II, and IV

146. Which part of the brain controls the involuntary action of breathing?
(A) Cerebellum brain region
(B) Cerebral cortex tissue
(C) Medulla oblongata
(D) Hypothalamic center

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147. A common symptom of both asthma and bronchitis is
(A) Coughing and wheezing
(B) Internal bleeding
(C) Severe skin rash
(D) Complete loss of voice

148. Which gas is produced in muscle cells during anaerobic respiration?
(A) Oxygen
(B) Carbon dioxide
(C) Nitrogen
(D) Carbon monoxide

149. The process of combustion requires an ignition temperature. Cellular respiration requires
(A) Sustained high external environmental temperature
(B) Enzymes at body temperature
(C) Direct exposure to focused natural sunlight
(D) Total absolute absence of aqueous water

150. Match the following locations in List I with their respective respiratory processes in List II.
List I: Location
P. Cytoplasm
Q. Mitochondria
R. Alveoli
S. Yeast cells
List II: Respiratory process
1. Krebs cycle
2. Gas exchange
3. Glycolysis
4. Alcoholic fermentation
(A) P-3, Q-1, R-2, S-4
(B) P-1, Q-3, R-4, S-2
(C) P-3, Q-2, R-1, S-4
(D) P-4, Q-1, R-2, S-3

151. An increase in physical activity will lead to
(A) A decrease in cellular respiration
(B) An increase in cellular respiration
(C) No change in respiratory rate
(D) Immediate cell death

152. Which of the following is true about exhalation?
(A) It is an active physiological process that requires a lot of cellular ATP
(B) Relaxation of diaphragm and rib muscles
(C) It significantly increases the overall total volume of the chest cavity
(D) It actively pulls fresh atmospheric air into the pulmonary lungs

153. A plant is kept in a dark room. Which of the following gas exchanges will primarily occur?
(A) Intake of CO_2 and release of O_2
(B) Intake of O_2 and release of CO_2
(C) Only intake of O_2 with no release
(D) No gas exchange at all

154. What happens to the rate of respiration in an organism when the surrounding temperature drops significantly (e.g., in a hibernating frog)?
(A) It increases dramatically
(B) It decreases
(C) It stops completely
(D) It turns completely anaerobic

155. One common difference between breathing in plants and breathing in animals is that
(A) Plant parts respire independently
(B) Plants utilize internal pulmonary lungs while animals utilize external branchial gills
(C) Plants do not require or need any molecular oxygen gas at all for cellular metabolism
(D) Plants transport respiratory gases throughout their tissues using fluid circulatory blood

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156. In human lungs, the bronchioles end in tiny air sacs called alveoli. The primary advantage of having millions of alveoli is
(A) To significantly increase the total overall physical weight of both lungs
(B) To greatly increase surface area for gas exchange
(C) To store large reserve amounts of atmospheric oxygen gas for many days
(D) To prevent airborne bacterial and viral respiratory lung infections

157. Which of the following represents the correct path of carbon dioxide as it leaves the body?
(A) Alveoli → Bronchioles → Bronchi → Trachea → Larynx → Pharynx → Nose
(B) Nose → Pharynx → Larynx → Trachea → Bronchi → Bronchioles → Alveoli
(C) Alveoli → Trachea → Bronchioles → Bronchi → Pharynx → Nose
(D) Trachea → Alveoli → Bronchi → Nose

158. Prolonged exposure to carbon monoxide is dangerous because it forms a stable compound with haemoglobin called
(A) Oxyhaemoglobin
(B) Carboxyhaemoglobin
(C) Carbaminohaemoglobin
(D) Methaemoglobin

159. When comparing an athlete to a non-athlete at rest, the athlete typically has a
(A) Higher heart rate and breathing rate
(B) Lower resting heart rate and higher vital capacity
(C) Smaller lung volume
(D) Complete absence of lactic acid production during sprints

160. Given below are two statements, one labeled as Assertion (A) and the other labeled as Reason (R).
Assertion (A): Smoking damages the cilia in the respiratory tract.
Reason (R): Damaged cilia cannot sweep dust and mucus out of the lungs, leading to a smoker's cough.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

161. Respiration in roots of a plant occurs by the process of diffusion from the
(A) Vascular phloem tissue
(B) Photosynthetic leaves
(C) Soil air spaces
(D) Deep underground water

162. How does the body clear the oxygen debt accumulated after heavy exercise?
(A) By voluntarily holding one's breath for a extended period
(B) By heavy breathing after exercise
(C) By drinking plenty of fresh pure water immediately after workouts
(D) By going to sleep immediately following vigorous activity

163. Which part of the human respiratory system helps maintain the temperature of the inhaled air?
(A) Pulmonary alveoli
(B) Nasal cavity
(C) Trachea windpipe
(D) Bronchial branches

164. The primary reason climbers carry oxygen cylinders to high altitudes is
(A) The high altitude atmospheric air is far too severely polluted
(B) Partial pressure of oxygen is low
(C) There is an absolute total vacuum with no atmospheric air at all
(D) To continuously generate heat energy and keep themselves warm

165. The opening and closing of stomatal pores is regulated by changes in the
(A) Guard cell turgor pressure
(B) Concentration of molecular oxygen gas in ambient air
(C) Prevailing atmospheric wind speed surrounding leaves
(D) Deep ambient soil temperature around plant roots

166. A disease causing the alveoli to lose their elasticity and merge into larger sacs with less surface area is
(A) Pneumonia
(B) Emphysema
(C) Tuberculosis
(D) Diphtheria

167. During the day, the CO_2 produced by plant respiration is
(A) Completely expelled through open leaf stomata
(B) Used up in photosynthesis
(C) Stored permanently within underground root tissues
(D) Converted directly into oxygen gas immediately

168. Which of the following is true for glycolysis?
(A) It requires oxygen
(B) It produces a large amount of ATP
(C) It takes place in the cytoplasm
(D) It occurs only in anaerobic organisms

169. What is the role of the C-shaped cartilaginous rings in the human trachea?
(A) To produce vocal acoustic sound frequencies
(B) To continuously filter dust and airborne grime
(C) To prevent tracheal collapse
(D) To facilitate alveolar gaseous exchange

170. Which gas is responsible for the foaming or rising of bread dough during baking?
(A) Pure oxygen gas
(B) Carbon dioxide
(C) Elemental nitrogen
(D) Pure hydrogen gas

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171. The respiratory pigment in human beings is formed primarily using which mineral?
(A) Calcium
(B) Iron
(C) Magnesium
(D) Potassium

172. If a person's vital capacity is measured, it is found by taking the sum of
(A) Tidal volume + IRV + ERV
(B) Normal tidal volume added to pulmonary residual volume
(C) Total lung capacity combined with residual air volume
(D) Inspiratory reserve volume plus pulmonary residual volume

173. What is the most immediate source of energy for cellular work?
(A) Glucose
(B) Glycogen
(C) ATP
(D) Fat

174. Which of the following statements about the interrelation between nutrition and respiration is most accurate?
(A) Respiration directly produces the organic food that human nutrition digests
(B) Nutrition supplies glucose oxidized in respiration
(C) Both processes are completely independent and do not affect each other at all
(D) Nutrition requires pure oxygen gas whereas respiration requires carbon dioxide gas

175. Arrange the following steps of cellular aerobic respiration in the correct sequence:
1. Complete oxidation in mitochondria
2. Breakdown of glucose into pyruvate
3. Release of carbon dioxide, water, and 38 ATP

(A) 2, 1, 3
(B) 1, 2, 3
(C) 3, 2, 1
(D) 2, 3, 1

176. What happens to the diaphragm when you forcefully exhale?
(A) It contracts forcefully and powerfully
(B) It moves downwards toward the abdomen
(C) It relaxes into a dome shape
(D) It flattens completely and horizontally

177. Which organisms exhibit cutaneous respiration (respiration through skin)?
(A) Aquatic bony fishes
(B) Earthworms and frogs
(C) Terrestrial insects
(D) Flying avian birds

178. What would happen if a potted plant is over-watered continuously for many days?
(A) The plant will continuously grow exceptionally fast and healthy
(B) Roots will die from lack of oxygen
(C) The plant will undergo extreme excess rates of photosynthesis
(D) The green leaves will release much more oxygen gas at night

179. The exchange of gases in alveoli takes place by the principle of
(A) Simple diffusion down a concentration gradient
(B) Active transport using ATP
(C) Osmosis of water
(D) Facilitated diffusion using carrier proteins

180. Consider the following statements distinguishing respiration from combustion:
I. Respiration is a cellular process, combustion is not.
II. Respiration releases energy in steps, combustion releases it all at once.
III. Enzymes control combustion, whereas respiration is uncontrolled.

Which of the above statements is/are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II, and III

181. In an insect, oxygen reaches the tissues directly through
(A) Haemoglobin in the blood
(B) Plasma
(C) Tracheoles
(D) Gills

182. A sudden, sharp pain or cramp in the leg muscles of a runner is usually treated with a hot water bath or massage. Why?
(A) It cools the muscular tissue down rapidly to reduce painful swelling
(B) It increases blood flow to break down lactic acid
(C) It turns accumulated muscular lactic acid

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directly into ethyl alcohol
(D) It completely and temporarily stops all cellular respiration in tissue

183. Which respiratory condition is characterized by a persistent cough, excess mucus production, and shortness of breath, often caused by long-term exposure to irritants like tobacco smoke?
(A) Chronic bronchitis
(B) Acute common cold infection
(C) Severe viral tonsillitis
(D) Chronic nasal sinusitis

184. The part of the respiratory system that branches directly off the trachea is the
(A) Bronchioles
(B) Pharynx
(C) Bronchi
(D) Alveoli

185. A person at high altitude breathes faster and deeper. This is an example of
(A) Acclimatization
(B) Genetic mutation process
(C) Biological evolution
(D) Winter hibernation state

186. Which chemical bond in ATP holds the most readily accessible energy for cellular processes?
(A) The strong chemical bond between adenine base and ribose sugar
(B) The bond between second and third phosphates
(C) The covalent chemical bond connecting carbon and hydrogen atoms
(D) The covalent bond existing between oxygen and carbon atoms

187. The breakdown of pyruvate to give carbon dioxide, water, and energy takes place in
(A) Cytoplasmic fluid
(B) Mitochondria
(C) Chloroplast stroma
(D) Cell nucleus

188. Which structure separates the right and left sides of the nasal cavity?
(A) Epiglottis cartilage
(B) Nasal septum
(C) Hard bony palate
(D) Soft tissue palate

189. During human respiration, what is the role of the pleural fluid between the pleural membranes?
(A) It traps dust and fine atmospheric particles effectively
(B) It reduces friction during lung movement
(C) It exchanges respiratory gases directly with alveoli
(D) It produces immune white blood cells continuously

190. Consider the following statements about high altitude breathing:
I. Oxygen concentration in the air is lower than at sea level.
II. The body compensates by increasing the breathing rate.
III. Long-term exposure increases red blood cell production.
IV. The atmospheric pressure at high altitude is higher than at sea level.
Which of the above statements is/are correct?
(A) I, II, and III
(B) II, III, and IV
(C) I, III, and IV
(D) I, II, and IV

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191. During rigorous exercise, if the energy demand is extremely high, which of the following processes will take place in the muscle cells?
(A) Only aerobic respiration
(B) Both aerobic and anaerobic respiration
(C) Only fermentation
(D) Photorespiration

192. Which of the following best defines vital capacity?
(A) The average standard amount of air inhaled normally during a relaxed breath
(B) Max air expelled after maximum inhalation
(C) The total volume of air that remains in lungs after a forceful expiration
(D) The total combined volumetric capacity of both human lungs overall

193. The primary organ for phonation (sound production) in humans is the
(A) Pharynx
(B) Larynx
(C) Trachea
(D) Esophagus

194. In humans, air is drawn into the lungs when
(A) Thoracic volume increases and pressure decreases
(B) Thoracic volume decreases and pressure increases
(C) Both thoracic volume and pressure increase
(D) Both thoracic volume and pressure decrease

195. Match the respiratory process in List I with its end products in List II.

List I: Respiratory process

P. Aerobic respiration
Q. Anaerobic respiration in yeast
R. Anaerobic respiration in muscle
S. Photosynthesis

List II: End products

1. Glucose and Oxygen
2. Lactic acid and minimal ATP
3. Ethanol, CO_2, and minimal ATP
4. CO_2, Water, and 38 ATP

(A) P-4, Q-3, R-2, S-1
(B) P-1, Q-2, R-3, S-4
(C) P-4, Q-2, R-3, S-1
(D) P-3, Q-4, R-1, S-2

196. The continuous network of air tubes in an insect is kept open by
(A) High blood pressure
(B) Rings of chitin
(C) Cartilage rings
(D) Bony structures

197. Which blood vessels surround the alveoli to facilitate gas exchange?
(A) Arteries
(B) Veins
(C) Capillaries
(D) Lymph vessels

198. The toxic substance present in cigarette smoke that paralyzes the cilia of the respiratory tract is
(A) Carbon dioxide
(B) Tar
(C) Oxygen
(D) Water vapor

199. What ensures that the lungs always contain a certain volume of air, even after a forceful exhalation?
(A) Vital capacity
(B) Residual volume
(C) Tidal volume
(D) Inspiratory reserve volume

200. The ultimate source of energy that is locked in the glucose molecule and later released during cellular respiration is
(A) Geothermal energy
(B) Solar energy
(C) Wind energy
(D) Magnetic energy

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ANSWERS

1. (B) Respiration
Cellular respiration is a fundamental biological metabolic process where organic food molecules, primarily glucose, undergo chemical oxidation within cells. This reaction breaks down complex biochemical nutrients to release chemical energy stored in molecular bonds, which is then captured as adenosine triphosphate to power various vital activities, maintenance, and metabolic functions in living organisms.

2. (D) Aerobic respiration requires free molecular oxygen
Cellular respiration is classified based on oxygen requirement into aerobic and anaerobic pathways. Aerobic respiration strictly requires atmospheric oxygen as the final electron acceptor in the electron transport chain to completely oxidize pyruvate into carbon dioxide and water. Conversely, anaerobic respiration occurs without oxygen, yielding far less energy and different organic end products during metabolic activity.

3. (A) Pyruvate
Glycolysis is the initial metabolic stage of cellular respiration occurring in the cytoplasm, independent of oxygen. During this ten-step enzymatic process, one six-carbon glucose molecule undergoes partial oxidation and chemical cleavage to yield two three-carbon molecules of pyruvate, along with a net production of two ATP and two reduced NADH carrier molecules.

4. (C) Mitochondria
The Krebs cycle, also known as the citric acid cycle, takes place within the fluid matrix of mitochondria in eukaryotic cells. Pyruvate generated during cytoplasmic glycolysis is imported into the mitochondrial matrix, converted to acetyl-CoA, and oxidized through a series of cyclic enzymatic steps, releasing carbon dioxide and generating reduced coenzymes for energy synthesis.

5. (A) Nostrils, Pharynx, Larynx, Trachea, Alveoli
Air enters through nostrils into the nasal cavity, passing sequentially into the pharynx, which serves as a common passage. It then flows through the larynx housing vocal structures, enters the trachea supported by cartilaginous rings, and branches through bronchi into smaller bronchioles, finally arriving at microscopic alveoli where pulmonary gaseous exchange occurs with blood.

6. (D) Stomata
Stomata are microscopic pores located primarily on the epidermal surface of plant leaves. Each stomatal opening is regulated by a pair of specialized guard cells that control pore aperture through turgor changes. These pores facilitate direct gaseous exchange of carbon dioxide and oxygen between internal leaf tissues and the surrounding environment during photosynthesis and respiration.

7. (B) Asthma
Asthma is a chronic inflammatory disorder of the respiratory airways characterized by hyperresponsiveness to various environmental allergens and triggers. Exposure to these irritants causes bronchospasm, mucosal swelling, and excessive mucus secretion, leading to airway narrowing, heightened resistance to airflow, and symptoms such as difficulty breathing, chest tightness, coughing, and persistent audible wheezing.

8. (C) Lactic acid
During strenuous physical exertion, oxygen supply to skeletal muscle tissue becomes insufficient for aerobic respiration, triggering anaerobic metabolism. Pyruvate is reduced to lactic acid, which accumulates in muscle tissues, causing fatigue. Following exercise, extra oxygen is consumed to metabolize this accumulated lactic acid back into glucose in the liver, resolving the oxygen debt.

9. (D) It produces ATP during cellular respiration
Mitochondria are double-membraned eukaryotic organelles termed cellular powerhouses due to their central role in aerobic respiration. They host the Krebs cycle and oxidative phosphorylation on their folded inner membranes. These metabolic pathways continuously break down metabolic intermediates, generating abundant

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chemical energy stored as adenosine triphosphate molecules to meet cellular metabolic needs.

10. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
The tracheal wall contains C-shaped rings composed of hyaline cartilage that extend along its length. These firm cartilaginous structures offer structural support and flexibility, holding the airway open against internal negative pressure generated during inspiration. This mechanical reinforcement ensures that the air passage remains continuously open without collapsing, allowing unobstructed airflow into lungs.

11. (B) ATP
Adenosine triphosphate functions as the universal energy currency within living cells due to high-energy phosphoanhydride bonds linking its phosphate groups. Enzymatic hydrolysis of these terminal bonds releases readily usable free energy needed to drive endergonic cellular processes, including mechanical contraction, active transmembrane ion transport, protein synthesis, signal transduction, and continuous cellular maintenance activities.

12. (B) Gills
Fish utilize specialized vascular respiratory organs called gills for aquatic gas exchange. Situated under protective opercular covers, gills feature thin, highly branched filamentous structures dense with blood capillaries. As water passes through the gills, dissolved oxygen diffuses directly into the bloodstream while carbon dioxide diffuses out into the surrounding water via efficient countercurrent exchange mechanisms.

13. (A) It contracts and flattens
Inhalation is an active respiratory phase driven by muscular contraction. The dome-shaped muscular diaphragm receives nerve impulses, causing it to contract and flatten downward toward the abdominal cavity. Simultaneously, intercostal muscles elevate the rib cage, expanding thoracic volume, reducing intrapulmonary pressure below atmospheric levels, and drawing atmospheric air smoothly into the expanding lungs.

14. (C) It yields ethanol, CO_2, and energy
Alcoholic fermentation is an anaerobic pathway carried out by yeast cells in the absence of oxygen. During this process, glucose is broken down via glycolysis into pyruvate, which is subsequently decarboxylated and reduced by enzymes, producing ethyl alcohol, carbon dioxide gas, and a net output of two adenosine triphosphate energy molecules per glucose.

15. (A) I and II
Respiration is a vital metabolic process occurring continuously day and night in all living organisms, including plants, to release stored chemical energy as ATP. Unlike combustion, which is a rapid, non-enzymatic, high-temperature chemical reaction releasing heat and light all at once, cellular respiration proceeds through a series of enzyme-controlled, step-wise reactions.

16. (C) Haemoglobin
Haemoglobin is an iron-containing metalloprotein found within human red blood cells. It reversibly binds molecular oxygen in alveolar capillaries to form oxyhaemoglobin, facilitating efficient oxygen transport through systemic circulation to metabolizing body tissues. Additionally, haemoglobin assists in carbon dioxide transport back to the respiratory surface, helping maintain systemic acid-base physiological homeostasis.

17. (B) Tracheal system
Insects possess an internal gas exchange network known as the tracheal system, independent of their circulatory fluid. External lateral openings called spiracles connect to an extensive framework of chitin-lined tracheal tubes that branch into microscopic tracheoles. These tiny tubes deliver gaseous oxygen directly to individual body cells while removing metabolic carbon dioxide via diffusion.

18. (D) The partial pressure of oxygen is lower
At high elevations, total atmospheric pressure decreases, leading to a proportional reduction in the partial pressure of molecular oxygen. Consequently, each breath delivers fewer oxygen molecules into pulmonary alveoli, lowering arterial oxygen saturation. To compensate for reduced oxygen diffusion into blood, the central nervous system increases ventilation frequency and depth to maintain oxygenation.

19. (A) Epiglottis
The epiglottis is a flexible cartilaginous flap situated at the root of the tongue above the laryngeal inlet. During deglutition, the

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larynx moves upward while the epiglottis folds downward over the glottis. This mechanical reflex action completely seals the entrance to the trachea, guiding food and liquids safely into the esophagus during swallowing movements.

20. (A) P-3, Q-4, R-1, S-2
Fish utilize vascular gills adapted for extracting oxygen dissolved in water, whereas earthworms rely on cutaneous respiration across their moist, thin epidermal outer surface. Insects possess an internal tracheal system with branching air tubes, and humans utilize specialized paired pulmonary lungs containing alveoli to perform highly efficient gas exchange with circulating blood.

21. (A) Vital capacity
Vital capacity represents the total maximum volume of air an individual can forcibly expire from the lungs following a maximal inhalation effort. It encompasses three distinct physiological lung volumes: inspiratory reserve volume, resting tidal volume, and expiratory reserve volume. This measurement reflects overall pulmonary ventilatory reserve, chest wall elasticity, and respiratory muscle strength.

22. (D) Lenticels
In woody stems and mature roots covered by impermeable cork or bark tissues, gaseous exchange occurs through specialized microscopic openings called lenticels. These raised, loosely packed cellular structures create intercellular spaces in the periderm, allowing atmospheric oxygen to diffuse directly to underlying living cortical and vascular tissues while permitting carbon dioxide to escape outward.

23. (B) Lactic acid
Strenuous muscular exertion creates an oxygen deficit in skeletal muscle fibers, preventing complete aerobic breakdown of glucose. Consequently, cells switch to anaerobic glycolysis, reducing pyruvate to lactic acid. The accumulation of lactic acid and associated hydrogen ions lowers intracellular pH, inducing muscle fatigue, temporary cellular discomfort, and painful muscular cramps during high-intensity physical activity.

24. (C) Destruction of respiratory cilia
Cigarette smoke contains toxic chemicals and hot particulates that paralyze and destroy microscopic ciliated epithelial cells lining the respiratory tract. Cilia normally sweep mucus, trapped dust particles, and microbes upward toward the pharynx. Their loss impairs the mucociliary clearance mechanism, predisposing the lungs to chronic inflammation, mucus accumulation, persistent coughing, and serious respiratory infections.

25. (A) I, II, and III
Alveoli are tiny, thin-walled, balloon-like air sacs located at the terminus of respiratory bronchioles in human lungs. Their thin single-cell layer walls are densely surrounded by extensive pulmonary blood capillary networks, creating an enormous cumulative surface area dedicated to efficient gaseous diffusion. Cartilaginous rings support upper large airways like trachea, not delicate alveoli.

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26. (A) Carbon dioxide, water, and energy
Aerobic respiration involves the complete chemical oxidation of a six-carbon glucose molecule in the presence of molecular oxygen. Occurring through glycolysis, the Krebs cycle, and oxidative phosphorylation, this reaction fully converts glucose into inorganic end products, specifically six carbon dioxide molecules and six water molecules, while generating approximately thirty-eight adenosine triphosphate energy molecules.

27. (B) Cytoplasm
Glycolysis represents the foundational anaerobic phase of cellular respiration occurring within the fluid cytoplasm of living cells. It consists of ten sequential enzymatic steps that convert one glucose molecule into two pyruvate molecules. Because it does not require oxygen or specialized organelle structures, glycolysis occurs universally across both prokaryotic and eukaryotic cellular organisms.

28. (B) Respiration is an enzyme-controlled process
Cellular respiration is a controlled biochemical process occurring inside living cells at physiological temperatures, mediated by specific catalytic enzymes that release energy stepwise into stored chemical ATP molecules. In contrast, combustion is a rapid, non-enzymatic physicochemical oxidation occurring at elevated temperatures, releasing all stored chemical energy at once as uncontrolled heat and light.

29. (A) It decreases
Exhalation is typically a passive phase of breathing where the contracted diaphragm relaxes, returning to its upward dome-shaped position, and intercostal muscles lower the rib cage inward. These movements decrease the structural volume of the thoracic cavity, elevating intrapulmonary air pressure above atmospheric pressure, which forces carbon dioxide-rich air out of lungs.

30. (C) Dissolved bicarbonate ions in plasma
Carbon dioxide produced by metabolizing tissues enters systemic capillaries and diffuses into red blood cells, where carbonic anhydrase hydrates it into carbonic acid. This acid dissociates into hydrogen and bicarbonate ions. The majority of bicarbonate ions diffuse out into blood plasma, transporting carbon dioxide safely in dissolved ionic form to pulmonary capillaries.

31. (D) Soil air spaces are cleared of oxygen
Roots require atmospheric oxygen present within soil air spaces to perform cellular respiration for growth and active mineral absorption. In waterlogged conditions, excess water fills these interstitial pore spaces, displacing air and creating an anaerobic environment. Deprived of oxygen, root cells cannot synthesize sufficient ATP, leading to toxic metabolite accumulation and root death.

32. (C) Larynx
The larynx, commonly designated as the voice box, is a hollow cartilaginous structure located between the pharynx and trachea. It contains elastic mucosal folds known as vocal cords. Air forced past these adducted vocal cords during exhalation causes controlled vibrations, producing primary sound waves modified by pharyngeal, oral, and nasal cavities for vocalization.

33. (B) Release of oxygen and uptake of carbon dioxide
During daylight hours, plant leaves undergo both photosynthesis and cellular respiration simultaneously. However, the rate of photosynthetic carbon dioxide uptake and oxygen production significantly exceeds the rate of respiratory oxygen consumption and carbon dioxide release. Consequently, the net gaseous exchange in leaves during daytime is oxygen liberation into the atmosphere and carbon dioxide absorption.

34. (D) Bronchi
Bronchitis is a respiratory disease defined by inflammation of the mucous membranes lining the bronchial airways. Infection, smoking, or pollutant exposure irritates these air passages, causing mucosal swelling, excessive thick phlegm production, and hyperresponsiveness. This narrowing of the bronchial lumen impairs normal airflow, leading to persistent coughing, chest discomfort, wheezing, and breathing difficulty.

35. (A) 3, 1, 4, 2
During human respiration, inhaled air first flows through conducting airways into pulmonary alveoli. Oxygen then diffuses across alveolar membranes into surrounding capillaries, binding to red blood cell haemoglobin. The circulatory system transports oxygenated blood to systemic tissues, where oxygen dissociates and diffuses into cells to drive mitochondrial cellular respiration and ATP generation.

36. (C) Oxidation of glucose to yield ATP
Nutrition provides nutrient molecules, notably glucose obtained through digestion and absorption, which act as primary chemical fuel substrates. Cellular respiration utilizes these absorbed glucose molecules, oxidizing them through enzymatic pathways in the presence of oxygen to release stored chemical energy as ATP, directly linking nutrient intake to energy production for physiological cellular work.

37. (C) 38 ATP
Complete aerobic respiration of one single glucose molecule yields a theoretical maximum of thirty-eight adenosine triphosphate molecules. This total comprises two net ATP generated during cytoplasmic glycolysis, two ATP synthesized directly in the Krebs cycle, and approximately thirty-four ATP synthesized via electron transport and oxidative phosphorylation along the inner mitochondrial membrane.

38. (B) Ethanol and CO_2
In an environment lacking oxygen, yeast cells undergo anaerobic respiration, specifically alcoholic fermentation. Glucose is broken down through glycolysis into pyruvate, which undergoes enzymatic decarboxylation and reduction in the cytoplasm. This pathway converts pyruvate into ethyl alcohol and carbon dioxide gas while generating two net ATP molecules to support yeast cellular functions.

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39. (C) Diffusion
Pulmonary gaseous exchange across the alveolar-capillary membrane occurs entirely via simple passive diffusion driven by partial pressure gradients. Inhaled air provides a higher partial pressure of oxygen in alveoli than in deoxygenated capillary blood, driving oxygen inward. Conversely, higher partial pressure of carbon dioxide in blood causes it to diffuse outward into alveoli.

40. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Water holds a significantly lower concentration of dissolved molecular oxygen compared to the abundant oxygen content present in atmospheric air. To compensate for this lower availability and satisfy physiological metabolic demands, aquatic organisms like fish must pass water rapidly across their respiratory surfaces, resulting in a much faster breathing rate than terrestrial animals.

41. (C) Carbon monoxide
Carbon monoxide exhibits an extremely high chemical affinity for haemoglobin, approximately two hundred times greater than that of oxygen. When inhaled, it readily binds to iron centers in haemoglobin to form stable carboxyhaemoglobin. This severely impairs oxygen binding and transport capacity in blood, causing cellular hypoxia, systemic asphyxiation, and potentially fatal carbon monoxide toxicity.

42. (B) Physical activity levels
The rate of respiration is primarily governed by physiological energy demands, which fluctuate with physical activity levels. Vigorous muscle activity increases ATP consumption, elevated carbon dioxide production, and oxygen depletion. Sensory chemoreceptors detect changes in blood carbon dioxide concentration and pH, sending nerve impulses to brain respiratory centers to adjust breathing frequency and depth accordingly.

43. (D) Guard cells
Stomatal pores on plant leaf surfaces are bounded by two specialized crescent-shaped epidermal cells called guard cells. Guard cells contain chloroplasts and possess thick inner cell walls. Changes in their osmotic pressure and turgidity, driven by light and ion transport, cause these cells to swell or shrink, thereby dynamically controlling stomatal opening and closing.

44. (A) Carbon dioxide
Lime water is a clear solution of calcium hydroxide. When exhaled air containing carbon dioxide is bubbled through it, carbon dioxide reacts with calcium hydroxide to form insoluble calcium carbonate precipitate and water. This chemical reaction produces a characteristic milky white suspension, confirming that human exhaled air contains a significant concentration of carbon dioxide gas.

45. (A) I and II
The diaphragm is a large, dome-shaped musculotendinous sheet separating the thoracic and abdominal cavities. During inhalation, it contracts and flattens to expand thoracic volume. During exhalation, the muscle relaxes and reverts to its relaxed, upwardly curved dome shape, helping reduce thoracic volume and expel carbon dioxide from the respiratory system.

46. (C) Alveoli
Alveoli are tiny, highly vascularized microscopic air sacs that constitute the primary structural and functional units of lungs. Their ultra-thin single-cell epithelial walls are surrounded by a dense capillary network. This structural arrangement minimizes diffusion distance, facilitating continuous, efficient gas exchange between atmospheric air in alveoli and circulating blood within pulmonary capillaries.

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47. (A) 2
Anaerobic respiration in human muscle cells, known as lactic acid fermentation, breaks down one glucose molecule into two lactic acid molecules without using oxygen. Because pyruvate does not enter the mitochondria for Krebs cycle processing, the net energy yield is limited solely to the two ATP molecules generated during the preliminary cytoplasmic glycolysis pathway.

48. (D) Tar
Tobacco smoke contains a dark, viscous chemical residue known as tar. When inhaled, tar condenses inside respiratory passages, coating mucosal linings and paralyzing microscopic cilia responsible for airway clearance. Furthermore, tar carries carcinogenic substances and irritants that cause persistent localized inflammation, breakdown of delicate alveolar walls, and long-term loss of elastic pulmonary tissue.

49. (B) Fermentation
Fermentation is an anaerobic metabolic pathway carried out by various microorganisms and cells to extract chemical energy from organic nutrients without requiring molecular oxygen. During fermentation, glucose undergoes partial oxidation through glycolysis to form pyruvate, which is subsequently converted into metabolic end products like ethanol or lactic acid, producing limited adenosine triphosphate energy.

50. (B) By release through stomata
During resting states or periods lacking light, plants perform cellular respiration while photosynthetic activity is inactive or minimal. Carbon dioxide generated continuously as a byproduct of mitochondrial carbohydrate oxidation diffuses through intercellular spaces in leaf tissues and is excreted into the surrounding atmosphere primarily through open stomatal pores present on leaf surfaces.

51. (A) Max air exhaled after deepest inhalation
Vital capacity is defined as the maximum volume of air a person can forcefully expel from their lungs after achieving maximum deep inspiration. Measured using spirometry, it combines tidal volume, inspiratory reserve volume, and expiratory reserve volume, serving as a vital clinical diagnostic index for assessing pulmonary mechanics, lung expansion capabilities, and respiratory muscle functional health.

52. (B) Both aerobic and anaerobic respiration
The enzymatic breakdown of a six-carbon glucose molecule into two three-carbon pyruvate molecules occurs during glycolysis within the cytoplasm. This fundamental metabolic pathway does not require molecular oxygen and serves as the indispensable universal first stage for both aerobic respiration in mitochondria and anaerobic respiration pathways in various biological cells and organisms.

53. (C) To increase surface area for ATP synthesis
The inner membrane of mitochondria features extensive inward folds known as cristae. These structural convolutions greatly expand the total functional membrane surface area available to accommodate electron transport chain complexes, coenzymes, and ATP synthase enzymes. This high surface area maximizes oxidative phosphorylation efficiency and overall cellular adenosine triphosphate production capacity.

54. (D) Oxyhaemoglobin
In pulmonary capillaries, molecular oxygen diffuses from alveoli into red blood cells and binds reversibly to iron ions within haemoglobin proteins, forming oxyhaemoglobin. This chemical binding alters the structural conformation and light absorption spectrum of the haemoglobin molecule, causing oxygenated arterial blood to display a characteristic bright red coloration throughout systemic arterial circulation.

55. (B) Ribs move up and out → Diaphragm contracts → Chest cavity expands
Inhalation begins when external intercostal muscles contract, pulling the rib cage upward and outward while the muscular diaphragm contracts and flattens downward. These coordinated muscular actions expand the thoracic cavity in all dimensions, reducing internal intrapulmonary pressure below atmospheric levels and causing ambient air to rush smoothly through airways into expanding lungs.

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56. (B) Are rich in blood vessels with large surface area
Fish gills are extraordinarily efficient respiratory structures composed of delicate gill filaments subdivided into microscopic secondary lamellae. These lamellae provide an immense total surface area and are densely infused with blood capillaries. The extremely thin epithelial barrier permits rapid gaseous diffusion between surrounding water and circulating blood via countercurrent exchange mechanics.

57. (D) Emphysema
Emphysema is a chronic obstructive pulmonary disease primarily induced by long-term exposure to tobacco smoke or environmental pollutants. Chronic inflammatory responses trigger enzymatic destruction of alveolar septa, causing tiny air sacs to collapse into enlarged, inelastic spaces. This structural breakdown severely decreases available surface area for gas exchange, causing severe shortness of breath.

58. (B) Body surface pores opening into tracheal tubes
Insects feature tiny lateral openings called spiracles along their thoracic and abdominal body walls. These spiracles act as controllable

valves that open into an internal network of air-filled tracheal tubes. Atmospheric air enters spiracles and flows through branching tracheoles, delivering oxygen directly to individual metabolizing tissues without relying on a circulatory vascular system.

59. (D) Trees release CO_2 at night due to respiration
At night, plants cannot perform photosynthesis due to the absence of sunlight, meaning oxygen production ceases completely. However, cellular respiration continues uninterrupted, consuming ambient oxygen and continuously releasing carbon dioxide gas into the surrounding air. Sleeping under a large tree exposes individuals to elevated carbon dioxide levels and reduced local oxygen concentrations.

60. (A) P-2, Q-3, R-4, S-1
Microscopic pulmonary alveoli serve as primary sites for gaseous exchange, while the cartilaginous larynx functions in vocal sound production. The muscular diaphragm acts as the principal muscle driving pulmonary ventilation, and iron-rich haemoglobin proteins specialized in red blood cells bind and transport gases through systemic and pulmonary circulatory pathways.

61. (C) Mitochondria
Following glycolysis in the cytoplasm, pyruvate is actively transported into the mitochondrial matrix under aerobic conditions. Inside mitochondria, pyruvate undergoes oxidative decarboxylation to form acetyl-CoA, which enters the Krebs cycle. Subsequent electron transport along inner mitochondrial cristae achieves complete oxidation of pyruvate into carbon dioxide, water, and abundant adenosine triphosphate energy.

62. (C) Pyruvate
Glycolysis is the common metabolic pathway shared by both aerobic and anaerobic cellular respiration. It breaks down glucose in the cytoplasm into two molecules of pyruvate without consuming oxygen. Pyruvate serves as the key central intermediate, which is either further oxidized in mitochondria during aerobic respiration or converted into ethanol or lactate during anaerobic pathways.

63. (A) Adenosine Triphosphate
ATP stands for Adenosine Triphosphate, an essential organic nucleotide composed of an adenine nitrogenous base, a ribose sugar, and three sequentially bound phosphate groups. High-energy bonds connecting these phosphate groups store readily available chemical energy released during cellular respiration, fueling enzymatic reactions, cellular movement, active transport, and continuous biological synthesis.

64. (B) Insufficient oxygen reaching the body tissues
Hypoxia is a physiological state characterized by inadequate oxygen delivery to tissue cells for normal cellular respiration. At high altitudes, reduced barometric pressure lowers atmospheric oxygen partial pressure, decreasing oxygen diffusion across alveolar membranes into blood. This leads to diminished arterial oxygen saturation, tissue oxygen deprivation, fatigue, dizziness, and altitude sickness symptoms.

65. (A) I, II, and IV
Plants undergo continuous cellular respiration day and night to sustain life processes, with roots absorbing oxygen from soil air spaces. Overall metabolic activity and respiration rates in plants are significantly lower than in active animals. Primary gas exchange in leaves occurs through stomatal pores rather than stem lenticels, which are restricted to woody stems.

66. (B) Trachea and bronchi
Cartilaginous rings are structural features present in the walls of the human trachea and primary bronchial tubes. Composed of hyaline cartilage, these C-shaped structures provide rigid structural reinforcement to the upper respiratory tract, preventing airway collapse during pressure changes accompanying inspiration and maintaining continuous, unobstructed airflow to and from lungs.

67. (A) Lactic acid is fully oxidized to CO_2 and water
Oxygen debt accumulated during strenuous exercise is fully repaid during post-exercise recovery when sustained heavy breathing delivers excess oxygen to tissues. In the liver and muscle cells, this oxygen powers the oxidation of accumulated lactic acid back into pyruvate, which is subsequently oxidized to carbon dioxide and water or converted back into glycogen.

68. (B) Warm, moisten, and filter air
As atmospheric air passes through the nasal cavity during inhalation, lined ciliated mucosa and vascular networks perform vital conditioning

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functions. Mucus traps foreign dust particles and microbes, ciliary beating sweeps debris outward, moisture humidifies dry air, and underlying blood capillaries warm incoming air to body temperature, protecting delicate internal pulmonary alveolar tissues.

69. (B) A rapid, uncontrolled reaction
Cellular respiration is a controlled, step-wise biological process governed by specific enzymes within living cells, releasing chemical energy gradually as ATP. Conversely, combustion is a non-biological, rapid chemical reaction occurring without enzymatic control at high ignition temperatures, breaking molecular bonds abruptly and releasing stored energy all at once as uncontrolled light and thermal heat.

70. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Aerobic respiration yields significantly more energy, approximately thirty-eight ATP per glucose, compared to anaerobic respiration, which yields only two ATP. This vast difference arises because aerobic respiration completely oxidizes glucose into simple inorganic molecules, carbon dioxide and water, fully releasing chemical energy stored within glucose molecular bonds via mitochondrial pathways.

71. (B) Asthma
Asthma is a chronic inflammatory disorder of the airway passages. Environmental triggers trigger hypersensitivity reactions in bronchial walls, causing smooth muscle contraction, mucosal inflammation, wall swelling, and excessive thick mucus production. This narrowing of bronchial lumens increases airflow resistance, leading to recurring episodes of chest tightness, coughing, wheezing, and labored breathing.

72. (C) Nitrogen
Atmospheric nitrogen gas makes up approximately seventy-eight percent of inhaled air. Because human cells lack biochemical pathways or enzymes to absorb or metabolize gaseous elemental nitrogen, it remains chemically inert within the respiratory system. Consequently, nitrogen passes in and out of lungs unchanged, exhaled in equal volume and concentration as inhaled air.

73. (C) Potassium hydroxide
Potassium hydroxide is a strong chemical alkali frequently used in plant physiological experiments to absorb carbon dioxide gas. When placed in a sealed experimental apparatus containing germinating seeds, potassium hydroxide chemically reacts with carbon dioxide produced by seed respiration, converting it to potassium carbonate and creating a measurable vacuum that demonstrates carbon dioxide release.

74. (A) A phosphate bond is broken
Adenosine triphosphate stores energy in high-energy phosphoanhydride bonds linking its terminal phosphate groups. When a cell requires energy for physiological work, enzymatic hydrolysis cleaves the terminal phosphate bond, converting ATP into adenosine diphosphate and an inorganic phosphate group. This bond cleavage releases readily available free energy to fuel cellular activities.

75. (A) 2, 4, 1, 3
Tracing the outward respiratory path from gas exchange sites back to the environment starts at microscopic alveoli. Carbon dioxide moves from alveoli into smaller respiratory bronchioles, passes into larger primary bronchi, travels upward through the central tracheal windpipe, and enters the pharyngeal cavity before exiting through upper nasal structures into the atmosphere.

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76. (C) Carbon dioxide
During the preparation of bread dough, added baker's yeast undergoes anaerobic fermentation, consuming sugars present in flour. This metabolic process yields ethyl alcohol and carbon dioxide gas. The generated carbon dioxide becomes trapped as expanding gas bubbles within the elastic gluten framework of dough, causing it to rise, puff up, and achieve a porous texture.

77. (B) Ribs
The rib cage consists of twelve pairs of curved bony ribs hinged to the thoracic vertebrae and sternum. These bones enclose and physically protect delicate lungs and heart. During pulmonary ventilation, intercostal muscles contract and relax to move ribs upward, outward, downward, and inward, altering thoracic cavity volume and driving mechanical breathing.

78. (C) Red blood cells
Red blood cells contain high concentrations of the specialized iron-containing protein haemoglobin. Molecular oxygen diffusing across alveolar capillaries into red blood cells binds reversibly to haemoglobin iron sites, forming oxyhaemoglobin. Red blood cells circulate through systemic blood vessels, transporting over ninety-eight percent of total bound oxygen directly to metabolizing body tissues.

79. (B) Oxygen supply cannot meet high energy demand
During high-intensity sprinting, rapid muscular contractions demand vast amounts of ATP faster than the cardiovascular system can deliver molecular oxygen to muscle mitochondria. To sustain energy production despite oxygen deficits, skeletal muscle fibers supplement aerobic respiration by switching to anaerobic glycolysis, reducing pyruvate to lactic acid to generate immediate local ATP.

80. (C) Citric acid cycle
The Krebs cycle is widely known as the citric acid cycle or tricarboxylic acid cycle. Named after Hans Krebs, this cyclic sequence of enzymatic reactions takes place within the mitochondrial matrix during aerobic respiration. It begins when acetyl-CoA combines with oxaloacetate to form citric acid, systematically oxidizing acetyl groups to release carbon dioxide and energy.

81. (A) Germinating seeds respire faster
Germinating seeds undergo rapid metabolic activation, cell division, and growth, demanding substantial energy synthesis. Consequently, their cellular respiration rate is extremely high, consuming large amounts of oxygen and rapidly producing measurable quantities of carbon dioxide. In contrast, dry dormant seeds exhibit minimal metabolic activity and very low respiration rates, making gas exchange detection difficult.

82. (C) Esophagus
The esophagus is a muscular tube belonging exclusively to the digestive system, responsible for conducting ingested food boluses from pharynx to stomach. In contrast, trachea, bronchi, and alveoli are integral structural components of the human respiratory system dedicated specifically to conducting atmospheric air and facilitating gaseous diffusion between air and circulating blood.

83. (B) Cilia
Cilia are microscopic, hair-like projections extending from epithelial cells lining the human nasal cavity and upper respiratory tract. Working alongside goblet cells that produce sticky mucus, cilia beat rhythmically in coordinated waves. This mucociliary escalator traps airborne dust particles, pollen, and microorganisms, sweeping them upward toward the pharynx for expulsion or swallowing.

84. (C) Thin, moist, with large surface area
An effective biological respiratory surface must possess specific structural adaptations to maximize gas exchange efficiency. It must be exceptionally thin to minimize diffusion distance, continuously moist to allow gases to dissolve in aqueous fluid before transport, highly permeable, and provide an expansive total surface area rich in capillary blood supply for continuous diffusion.

85. (A) I and II
Haemoglobin is a complex conjugated protein containing iron-porphyrin prosthetic groups located inside red blood cells, not dissolved in plasma. Each haemoglobin molecule features four iron atoms that exhibit high chemical affinity for molecular oxygen, reversibly binding oxygen molecules in pulmonary capillaries to form oxyhaemoglobin for efficient systemic tissue oxygen delivery.

86. (B) By releasing heat during cellular oxidation
Cellular respiration is an exergonic metabolic process where chemical energy stored in organic food molecules is released through stepwise oxidation. While a portion of this energy is captured as ATP, a significant fraction is dissipated as thermal heat. In endothermic warm-blooded animals, this metabolic heat generation maintains constant internal body temperature.

87. (B) Increase in red blood cell count
Prolonged residence at high altitudes exposes the body to chronic hypoxia due to lower atmospheric oxygen partial pressure. Renal cells sense reduced oxygen delivery and secrete erythropoietin hormone into blood. Erythropoietin stimulates bone marrow to accelerate erythropoiesis, increasing red blood

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cell count and total haemoglobin concentration to restore tissue oxygenation capacity.

88. (C) Carbon dioxide
The primary physiological driver regulating involuntary human breathing is the concentration of carbon dioxide in arterial blood. Central chemoreceptors in the medulla oblongata detect pH changes in cerebrospinal fluid caused by carbonic acid formation from dissolved carbon dioxide. Elevated carbon dioxide levels trigger nerve signals that increase respiratory rate and depth accordingly.

89. (B) Extract dissolved oxygen
Aquatic organisms like fish intake water continuously through their mouth and pump it forcefully across internal gill membranes. As water flows over thin, vascularized gill lamellae, oxygen dissolved in water diffuses down its concentration gradient into gill blood capillaries, while metabolic carbon dioxide diffuses out into water, satisfying respiratory gas exchange requirements.

90. (B) Waxy cuticle and guard cells
Plant leaves feature a transparent hydrophobic waxy cuticle coating the outer epidermis that prevents excessive non-stomatal water evaporation. Gas exchange occurs through microscopic stomatal pores whose opening and closing are dynamically regulated by paired guard cells, optimizing carbon dioxide absorption for photosynthesis while minimizing transpirational water loss according to environmental conditions.

91. (B) 21%
Inhaled atmospheric air consists primarily of approximately seventy-eight percent nitrogen, twenty-one percent molecular oxygen, nearly one percent argon, and small trace quantities of carbon dioxide, water vapor, and other noble gases. This twenty-one percent atmospheric oxygen concentration provides the necessary partial pressure gradient required for pulmonary diffusion in human lungs.

92. (B) 16%
Human exhaled air contains approximately sixteen percent molecular oxygen. During pulmonary gas exchange in alveoli, only a fraction of inhaled oxygen diffuses into capillary blood to satisfy systemic metabolic needs. The remaining oxygen, combined with unextracted air from anatomical dead spaces, is expelled during exhalation, lowering oxygen content from twenty-one percent to sixteen percent.

93. (C) Lung volumes and capacity
A spirometer is a specialized medical diagnostic device used in pulmonary function testing to measure inhaled and exhaled air volumes as a function of time. By recording metrics such as tidal volume, inspiratory reserve volume, expiratory reserve volume, and vital capacity, spirometry assesses lung ventilation efficiency and aids in diagnosing obstructive or restrictive pulmonary diseases.

94. (B) Mitochondria
The aerobic breakdown of pyruvate occurs within eukaryotic mitochondria. Pyruvate generated by cytoplasmic glycolysis is actively transported into the mitochondrial matrix, converted to acetyl-CoA, and processed through the Krebs cycle. Subsequent oxidative phosphorylation along inner mitochondrial membranes utilizes molecular oxygen to fully oxidize pyruvate into carbon dioxide, water, and ATP.

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95. (C) Oxygen deficit during exercise
Oxygen debt develops during high-intensity physical exercise when muscle energy expenditure exceeds the cardiovascular system's capacity to deliver sufficient oxygen for aerobic respiration. Muscle cells resort to anaerobic glycolysis to generate rapid ATP, accumulating lactic acid. The accumulated oxygen deficit must be repaid post-exercise through elevated oxygen consumption to metabolize lactic acid.

96. (B) Trachea
The trachea, or windpipe, contains sixteen to twenty C-shaped cartilaginous rings embedded within its anterior and lateral walls. Composed of flexible hyaline cartilage, these rings prevent tracheal collapse under negative pressure changes during forceful inhalation, keeping the upper respiratory airway permanently open for continuous airflow between pharynx and primary bronchi.

97. (B) Inhalation
Inhalation, or inspiration, is the active physiological process of drawing atmospheric air into lungs. It is initiated by contraction of the diaphragm and external intercostal muscles, which expands thoracic cavity volume. The

resulting drop in intrapulmonary pressure below atmospheric pressure draws air through conducting airways into pulmonary alveoli for gas exchange.

98. (B) Due to cartilaginous rings
The tracheal lumen is structurally fortified by C-shaped rings of rigid hyaline cartilage. During forceful exhalation or rapid inspiration, pressure within the airway can drop below surrounding atmospheric pressure. The rigid structural support provided by these cartilaginous rings prevents tracheal walls from collapsing inward, ensuring an unobstructed passageway for continuous respiration.

99. (B) It is soluble and mostly transported in plasma
Carbon dioxide is highly soluble in aqueous solutions compared to oxygen. Produced by metabolizing tissues, the vast majority of carbon dioxide diffuses into blood and reacts with water to form carbonic acid, which dissociates into bicarbonate ions. These bicarbonate ions dissolve readily and are transported mainly in blood plasma to lungs for exhalation.

100. (A) P-2, Q-4, R-1, S-3
Emphysema involves structural damage to alveolar walls, reducing gas exchange area, while carbon monoxide poisoning results from carboxyhaemoglobin formation. Asthma is characterized by bronchial hypersensitivity and airway inflammation, and temporary muscle cramps during heavy exercise are caused by localized accumulation of anaerobic metabolic lactic acid in muscle tissue.

101. (C) Carbon monoxide
Carbon monoxide present in tobacco smoke impairs blood oxygen transport. When inhaled into lungs, carbon monoxide rapidly diffuses across alveolar membranes into red blood cells, binding to haemoglobin with an affinity far exceeding oxygen. This forms carboxyhaemoglobin, reducing available haemoglobin sites for oxygen transport and leading to systemic tissue hypoxia.

102. (B) It breaks food down to release energy
Metabolism consists of anabolic synthesis pathways and catabolic degradative pathways. Cellular respiration is categorized as a catabolic process because complex, energy-rich organic food molecules, such as six-carbon glucose, are enzymatically broken down into smaller, simpler inorganic compounds like carbon dioxide and water, releasing stored chemical energy as ATP.

103. (B) Lower surface of the leaf
In most terrestrial dicotyledonous plants, stomata are distributed in much higher density on the lower abaxial epidermal surface of leaves. Placing stomata on the shaded lower surface reduces direct exposure to solar radiation and ambient wind currents, significantly minimizing transpirational water loss while maintaining efficient carbon dioxide absorption for leaf photosynthesis.

104. (C) It prevents food entering the windpipe
The epiglottis is a leaf-shaped elastic cartilaginous flap positioned at the entrance of the larynx. During deglutition, swallowing reflexes elevate the larynx, causing the epiglottis to fold backward and temporarily cover the glottis opening. This vital protective mechanism prevents ingested food boluses, fluids, and foreign material from entering the trachea.

105. (B) I, II, and III
Fish actively draw water through their mouth and force it over vascular gill structures protected by an operculum. Blood within gill lamellae flows in a direction opposite to water movement, establishing countercurrent exchange that maximizes dissolved oxygen uptake. Gills function only in water and collapse on land, preventing terrestrial atmospheric respiration.

106. (B) A decrease in air pressure inside the lungs
During inhalation, active contraction of the diaphragm and intercostal muscles increases total thoracic cavity volume. According to Boyle's law, expanding volume in a closed system causes internal air pressure to decrease. Consequently, intrapulmonary pressure drops below atmospheric pressure, creating a pressure gradient that draws external atmospheric air into lungs.

107. (B) Nasal cavity, Pharynx, Larynx, Trachea, Bronchi
Air entering the human respiratory system flows sequentially through external nostrils into the nasal cavity for filtering and warming. It passes into the shared pharyngeal space, through the laryngeal voice box, down the central cartilaginous trachea, and divides into primary

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left and right bronchi leading into lungs toward microscopic alveoli.

108. (B) Bronchial tubes
Bronchitis is a respiratory disease specifically affecting bronchial tubes, the conducting airways branching from trachea into lungs. Irritation from viral infections, smoking, or environmental pollutants causes inflammation of bronchial mucous membranes, producing edema, hypersecretion of thick mucus, coughing, wheezing, and impaired airflow through narrowed bronchial passageways.

109. (B) To trap dust and foreign particles
Mucus secreted by specialized goblet cells within the nasal epithelial lining plays a critical protective role in respiratory hygiene. Sticky mucus traps inhaled airborne dust, dirt particulates, pollen, pollutants, and potential microbial pathogens. Ciliated epithelial cells then sweep this particle-laden mucus toward the pharynx to prevent foreign matter from reaching delicate alveoli.

110. (D) Assertion (A) is false but Reason (R) is true.
Cellular respiration occurs continuously day and night in all living plant cells to maintain essential metabolic life processes and ATP production. Photosynthesis occurs only during daylight hours when light energy is available. Therefore, the assertion that plants respire only at night is false, while the statement regarding daytime photosynthesis is true.

111. (B) Anaerobic respiration
Brewing processes rely on yeast performing anaerobic respiration, specifically alcoholic fermentation, in oxygen-depleted environments. Yeast cells enzymatically break down glucose sugars in wort or fruit juices via glycolysis to form pyruvate, which is subsequently converted into ethanol and carbon dioxide gas, yielding alcohol content and natural carbonation in beverages.

112. (B) ATP
Free energy released during the step-wise chemical oxidation of glucose during cellular respiration is immediately captured to synthesize adenosine triphosphate from adenosine diphosphate and inorganic phosphate. ATP serves as the universal mobile chemical energy carrier within cells, directly driving endergonic metabolic reactions, structural movements, and active transmembrane transport.

113. (B) Vital capacity
Physical therapy for lung expansion focuses on maximizing pulmonary ventilation mechanics, intercostal muscle strength, and thoracic wall flexibility. These therapeutic breathing exercises directly target vital capacity, increasing the maximum volume of air an individual can forcibly expire after deep inspiration, thereby improving total respiratory capacity and gas exchange efficiency.

114. (A) Downwards and inwards
Exhalation is a passive respiratory event where external intercostal muscles relax, allowing the rib cage to move downwards and inwards under elastic recoil forces. Concurrently, the contracted diaphragm relaxes upward into its dome shape, reducing thoracic cavity volume, increasing intrapulmonary pressure, and forcing carbon dioxide-rich air out of lungs.

115. (B) Cockroach - Spiracles
Cockroaches and other insects utilize spiracles, lateral surface pores connected to an internal tracheal network for gas exchange. Earthworms respire cutaneously across moist skin rather than gills, fish possess vascular gills rather than lungs, and adult frogs utilize lungs and moist skin rather than stem lenticels found in plants.

116. (B) Three
Anatomically, the human right lung is larger and broader than the left lung and is divided into three distinct lobes: superior, middle, and inferior lobes, separated by deep horizontal and oblique fissures. In contrast, the left lung features only two lobes to accommodate the heart within the cardiac notch.

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117. (C) Cigarette smoking
Emphysema is a severe chronic pulmonary disease whose primary etiology is long-term cigarette smoking. Toxic chemicals in tobacco smoke induce persistent alveolar inflammation and stimulate elastase enzymes that degrade elastic fibers in lung parenchyma. This leads to irreversible destruction of alveolar walls, loss of elastic recoil, air trapping, and severe dyspnea.

118. (A) Digestion supplies glucose oxidized in respiration
The digestive system breaks down ingested food macronutrients into absorbable monosaccharides, primarily glucose, which are transported via blood circulation to tissue cells. Cellular respiration utilizes these absorbed glucose molecules, oxidizing them in the presence of inhaled oxygen to produce ATP, directly linking digestive nutrient supply to cellular energy generation.

119. (B) Produces water as a byproduct
A key distinction of aerobic respiration is the total oxidation of glucose to yield inorganic water and carbon dioxide as end products. Molecular oxygen serves as the final electron acceptor in the electron transport chain, combining with hydrogen ions to form water while generating high yields of ATP without toxic organic byproducts.

120. (C) Small surface area
An efficient respiratory surface requires an exceptionally large surface area to maximize total gas diffusion capacity. Additional critical characteristics of an optimal respiratory surface include an ultra-thin epithelial layer to minimize diffusion distance, a continuously moist interface to dissolve gases, and dense vascular capillary networks for rapid gas transport.

121. (B) It is lower
In a resting individual, metabolic activity and cellular ATP consumption in skeletal muscles are low, resulting in modest oxygen demands and minimal carbon dioxide production. Consequently, the central nervous system maintains a lower baseline respiratory rate compared to conditions of strenuous physical work, where elevated metabolic activity accelerates breathing rates.

122. (B) Oxygen
During daytime hours, plants perform both photosynthesis and cellular respiration. Because light intensity drives rapid photosynthetic reactions, the rate of photosynthetic carbon dioxide absorption and oxygen production far exceeds the rate of respiratory oxygen consumption and carbon dioxide release. Thus, the primary gas net released into the atmosphere during daytime is oxygen.

123. (B) Lungs and moist skin
Adult frogs possess dual respiratory mechanisms, utilizing both pulmonary and cutaneous respiration. On land or during physical activity, they breathe atmospheric air using simple sac-like lungs. Additionally, their thin, highly vascularized skin remains constantly moist with mucus, enabling continuous cutaneous gas exchange both in water and on land.

124. (C) Larynx
Human vocal cords are elastic muscular folds situated within the interior cavity of the larynx, or voice box. As air exhaled from lungs passes through the narrowed glottic space between adducted vocal cords, it induces controlled high-frequency vibrations that generate primary acoustic sound waves used for speech and vocalization.

125. (C) I and III
Adenosine triphosphate functions as the universal energy currency across all living domains, synthesized in both plant and animal cells. Energy is stored within high-energy phosphoanhydride bonds linking its phosphate groups. Enzymatic cleavage of the terminal phosphate bond converts ATP to ADP and inorganic phosphate, releasing free energy for cellular work.

126. (C) Respiration occurs only in the cells of higher animals.
Cellular respiration is a universal biological process occurring in all living organisms, ranging from unicellular bacteria and yeast to complex plants and animals. All living cells require continuous respiration to oxidize organic nutrients, generate adenosine triphosphate energy, and sustain essential metabolic pathways, cellular maintenance, and survival.

127. (D) Decreased heart rate
High altitude adaptation involves physiological mechanisms that compensate for ambient hypoxia caused by low atmospheric partial pressure of oxygen. Key adaptive responses include elevated breathing rates, increased red blood cell production via erythropoietin, enhanced capillary density, and temporary elevation of resting heart rate to maintain tissue oxygen delivery.

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128. (B) To meet increased oxygen demand
Vigorous physical activity like running accelerates skeletal muscle contraction rates, vastly increasing cellular ATP expenditure. Mitochondria require additional molecular oxygen to sustain high rates of aerobic respiration and clear rising carbon dioxide levels. Chemoreceptors detect metabolic changes, signaling respiratory centers in the brain to increase breathing rate and depth.

129. (B) Ethanol and carbon dioxide
During anaerobic respiration in yeast, known as alcoholic fermentation, oxygen is absent. The three-carbon pyruvate molecule generated via cytoplasm glycolysis undergoes enzymatic decarboxylation, releasing carbon dioxide to form acetaldehyde. Acetaldehyde is subsequently reduced by NADH, yielding two-carbon ethyl alcohol and regenerating NAD+ required for continued glycolysis.

130. (C) Circulatory system
Microscopic blood capillaries surrounding pulmonary alveoli are integral components of the cardiovascular circulatory system. Originating from pulmonary arteries carrying deoxygenated blood from the heart, these thin capillary networks facilitate rapid passive diffusion of carbon dioxide out of blood and oxygen into blood, returning oxygenated blood to the heart.

131. (B) Old woody stems and roots
Lenticels are specialized raised structural pores situated in the outer periderm bark of mature woody stems and older roots. Formed by loosely arranged cork cells with large intercellular spaces, lenticels permit direct atmospheric gas exchange, allowing oxygen to diffuse inward to living vascular cambium and parenchyma cells.

132. (B) Breathing
Breathing, or external ventilation, is the mechanical physiological process of moving air into and out of specialized respiratory organs like lungs or gills. It involves inhalation of oxygen-rich medium and exhalation of carbon dioxide-rich air, providing continuous gas transport between the external environment and internal circulatory systems.

133. (A) $C_6H_{12}O_6$
The exact chemical molecular formula for glucose is $C_6H_{12}O_6$. This hexose monosaccharide serves as the primary biochemical fuel substrate across living organisms. During cellular respiration, one molecule of $C_6H_{12}O_6$ undergoes systematic enzymatic oxidation in the presence of oxygen, forming carbon dioxide, water, and ATP energy.

134. (C) Amoeba
Amoeba is a single-celled microscopic aquatic protozoan lacking specialized respiratory organs or vascular systems. Because its cell membrane is in direct contact with surrounding water, Amoeba relies entirely on simple passive diffusion across its plasma membrane for gas exchange, absorbing dissolved oxygen and expelling metabolic carbon dioxide.

135. (B) Fermentation in yeast → Anaerobic respiration in muscle → Aerobic respiration
Alcoholic fermentation in yeast and anaerobic lactic acid respiration in muscle cells both perform partial glucose oxidation yielding only two ATP molecules per glucose. However, complete aerobic respiration fully oxidizes glucose through mitochondrial pathways, generating approximately thirty-eight ATP molecules, representing the highest energy yield per glucose molecule.

136. (B) Membrane around lungs
The pleura is a double-layered serous membrane surrounding human lungs within the thoracic cavity. It consists of an inner visceral pleura adhering directly to lung surfaces and an outer parietal pleura lining the chest wall. The narrow pleural cavity contains lubricating pleural fluid that reduces friction during respiratory expansion.

137. (B) It binds haemoglobin tightly, causing hypoxia
Carbon monoxide is highly toxic because it binds to haemoglobin with an affinity approximately two hundred times greater than oxygen, forming stable carboxyhaemoglobin. This competitive binding prevents oxygen from attaching to haemoglobin and impairs oxygen release in tissues, severely depriving vital organs of oxygen and causing fatal hypoxia.

138. (B) Matrix
The fluid-filled internal space enclosed by the inner mitochondrial membrane is designated as the mitochondrial matrix. Rich in specialized soluble enzymes, mitochondrial DNA, and ribosomes, the matrix serves as the primary site for acetyl-CoA formation and Krebs cycle

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reactions, oxidizing metabolic intermediates to generate reduced coenzymes for energy synthesis.

139. (A) Plant needs and environment
In plant tissues, the direction of gas diffusion through stomata and intercellular spaces is governed by relative partial pressure gradients and physiological state. Environmental conditions, such as light availability, dictate whether photosynthetic carbon dioxide uptake or respiratory oxygen consumption dominates, determining net inward or outward gaseous diffusion flux.

140. (B) Airways narrow from inflammation
Asthma patients experience exhalation difficulties primarily due to widespread bronchial airway inflammation and hyperresponsiveness. Exposure to triggers causes smooth muscle spasms, airway mucosal swelling, and excessive thick mucus secretion. This luminal narrowing significantly increases airflow resistance, trapping air in distal alveoli and making expiration prolonged and difficult.

141. (B) Internal respiration
Internal respiration, or tissue respiration, is the physiological exchange of gases occurring between systemic capillary blood and surrounding tissue cells. Driven by partial pressure gradients, molecular oxygen dissociates from oxyhaemoglobin and diffuses into tissue cells for cellular metabolism, while carbon dioxide produced by cells diffuses into blood.

142. (B) 12-20 breaths per minute
In healthy adult humans at rest, normal baseline respiratory frequency ranges between twelve and twenty breaths per minute. This resting ventilatory rate is tightly controlled by the respiratory center in the medulla oblongata to maintain optimal blood pH, arterial oxygen saturation, and systemic carbon dioxide clearance under basal metabolic conditions.

143. (B) Anaerobic respiration
During high-intensity sprinting, rapid muscle contractions create an oxygen deficit where oxygen delivery cannot match metabolic demand. Under these hypoxic conditions, skeletal muscle cells utilize anaerobic respiration, fermenting pyruvate into lactic acid within cytoplasm to maintain rapid ATP synthesis, resulting in temporary muscular fatigue and localized cramps.

144. (B) Tobacco smoking
Long-term tobacco smoking is the leading primary risk factor for chronic bronchitis. Inhaled cigarette smoke delivers harmful chemical toxins and irritating particulates that induce persistent mucosal inflammation, destroy protective ciliated epithelium, and stimulate hypersecretion of mucus in bronchial airways, leading to chronic cough and airway obstruction.

145. (B) I, III, and IV
During human inhalation, the muscular diaphragm contracts and flattens. Oxygen binds to haemoglobin forming oxyhaemoglobin, and exhalation involves thoracic volume reduction. Gas exchange occurs exclusively across microscopic alveolar-capillary membranes in lungs, whereas bronchi serve merely as non-respiratory conducting air passages.

146. (C) Medulla oblongata
Involuntary control of rhythmic human breathing is regulated by specialized respiratory centers located within the medulla oblongata of the brainstem. The medulla monitors arterial blood pH and carbon dioxide concentrations via chemoreceptors, sending autonomic nerve impulses along phrenic and intercostal nerves to coordinate respiratory muscle contraction rates.

147. (A) Coughing and wheezing
Both asthma and bronchitis involve chronic inflammation and narrowing of bronchial airways, leading to increased airflow resistance. Common clinical manifestations shared by both respiratory disorders include persistent coughing, dyspnea, chest tightness, and high-pitched wheezing sounds caused by turbulent airflow forced through narrowed, mucus-laden bronchial passages.

148. (B) Carbon dioxide
During anaerobic respiration in human muscle cells, glucose undergoes glycolysis to form pyruvate, which is subsequently converted into lactic acid without requiring oxygen. Additionally, cellular metabolic pathways operating under these strenuous conditions continuously produce carbon dioxide gas as a biochemical byproduct, which diffuses out into circulating blood.

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149. (B) Enzymes at body temperature
While inorganic combustion requires high ignition temperatures to initiate rapid, uncontrolled chemical oxidation, cellular respiration proceeds efficiently at normal physiological body temperatures. It relies on a complex sequence of specialized biological enzymes that catalyze step-wise substrate breakdown, capturing released chemical energy in ATP molecules without damaging living cells.

150. (A) P-3, Q-1, R-2, S-4
Cytoplasm hosts the initial anaerobic pathway of glycolysis, while mitochondria perform the Krebs cycle during aerobic respiration. Microscopic alveoli are specialized structural sites for respiratory gas exchange, and yeast cells execute anaerobic alcoholic fermentation in cytoplasm to produce ethanol and carbon dioxide as end products.

151. (B) An increase in cellular respiration
Increasing physical activity elevates skeletal muscle work, rapidly accelerating ATP consumption. To maintain cellular energy balance, rate-limiting mitochondrial metabolic pathways accelerate, driving an overall increase in cellular respiration. This metabolic acceleration consumes more oxygen and produces more carbon dioxide, stimulating proportional increases in breathing rate.

152. (B) Relaxation of diaphragm and rib muscles
Exhalation under resting conditions is a passive physical process driven by elastic recoil of lungs and chest wall. It occurs when the contracted diaphragm and external intercostal muscles relax, returning the diaphragm to its dome shape and lowering the rib cage, which decreases thoracic volume and expels air.

153. (B) Intake of O_2 and release of CO_2
A plant kept in darkness cannot perform light-dependent photosynthesis, so oxygen release and carbon dioxide uptake cease. However, cellular respiration continues uninterrupted to sustain living plant tissues. Consequently, the plant absorbs atmospheric oxygen from its surroundings to oxidize stored sugars and releases carbon dioxide as a metabolic byproduct.

154. (B) It decreases
When surrounding environmental temperatures drop significantly, ectothermic organisms like frogs undergo a sharp decline in internal body temperature and metabolic rate. Enzymes regulating cellular respiration function much slower at cold temperatures, markedly decreasing overall cellular oxygen consumption, carbon dioxide output, and respiratory rates during physiological hibernation.

155. (A) Plant parts respire independently
In plants, individual organs like leaves, stems, and roots perform gas exchange independently through local structures such as stomata and lenticels, with little internal gas transport between distant parts. In contrast, complex animals feature centralized respiratory systems and circulatory blood pathways that transport oxygen and carbon dioxide throughout the body.

156. (B) To greatly increase surface area for gas exchange
Human lungs contain approximately three hundred million microscopic alveoli. This extensive branching structure creates an enormous cumulative surface area, roughly seventy square meters, packed into a compact thoracic space. This massive surface area optimizes passive gas diffusion rates between alveolar air and surrounding pulmonary blood capillary networks.

157. (A) Alveoli → Bronchioles → Bronchi → Trachea → Larynx → Pharynx → Nose
Carbon dioxide eliminated from blood diffuses into microscopic pulmonary alveoli. During exhalation, air carrying carbon dioxide flows from alveoli into terminal bronchioles, passes into primary bronchi, ascends through the cartilaginous trachea, travels through the laryngeal voice box and pharyngeal cavity, and exits through nostrils into the environment.

158. (B) Carboxyhaemoglobin
Prolonged inhalation of carbon monoxide gas leads to the formation of carboxyhaemoglobin, a highly stable chemical complex formed when carbon monoxide binds to haemoglobin's iron sites. Carbon monoxide exhibits affinity over two hundred times higher than oxygen, preventing oxygen binding and transport, causing severe cellular hypoxia and life-threatening toxicity.

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159. (B) Lower resting heart rate and higher vital capacity
Endurance training induces cardiovascular and respiratory adaptations in athletes. Regular aerobic exercise strengthens cardiac muscle, increasing stroke volume and lowering resting heart rate. Concurrently, respiratory muscle strength and chest expansion improve, resulting in a significantly higher vital capacity and overall ventilatory efficiency compared to non-athletes at rest.

160. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Cigarette smoke contains irritating toxins and heat that paralyze and destroy microscopic ciliated cells lining respiratory pathways. Because damaged cilia can no longer rhythmically sweep trapped particles and excess mucus upward out of airways, smokers develop a persistent reflex cough to physically clear accumulated secretions from lungs.

161. (C) Soil air spaces
Roots absorb molecular oxygen required for cellular respiration directly from air spaces present between soil particles. Soil root hairs provide an extensive, thin surface area through which oxygen diffuses down its concentration gradient into epidermal root cells, while respiratory carbon dioxide diffuses outward into soil pore air spaces.

162. (B) By heavy breathing after exercise
Following vigorous exertion, elevated heavy breathing persists during recovery to pay off accumulated oxygen debt. Sustained rapid ventilation delivers extra oxygen to blood, fueling hepatic and muscular metabolic pathways that convert accumulated lactic acid back into pyruvate, glucose, and glycogen, restoring basal metabolic state.

163. (B) Nasal cavity
The nasal cavity plays a vital role in conditioning inhaled atmospheric air before it reaches delicate lung tissues. Lined with highly vascularized mucous membranes, rich capillary networks transfer body heat to incoming air, warming cold air to body temperature, while mucosal secretions add moisture to humidify dry air during passage.

164. (B) Partial pressure of oxygen is low
At high mountain altitudes, total atmospheric barometric pressure drops significantly, resulting in a proportional decrease in oxygen partial pressure. Although oxygen percentage remains near twenty-one percent, fewer oxygen molecules are present per unit volume of air, making ambient oxygen insufficient for physiological blood saturation without supplemental oxygen cylinders.

165. (A) Guard cell turgor pressure
Stomatal opening and closing are controlled by dynamic changes in guard cell turgor pressure. When guard cells actively accumulate potassium ions, water enters via osmosis, increasing turgor and causing thick inner cell walls to curve open. Conversely, loss of solutes causes guard cells to lose water, become flaccid, and close the pore.

166. (B) Emphysema
Emphysema is a progressive pulmonary disease characterized by permanent destruction of interalveolar septa. Chronic inflammation caused by smoking leads to enzymatic degradation of elastic fibers, causing delicate alveoli to lose elasticity and coalesce into larger, inefficient air spaces with drastically reduced surface area for gas exchange.

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167. (B) Used up in photosynthesis
During daylight hours, plant leaves undergo both photosynthesis and respiration simultaneously. The rate of photosynthetic carbon dioxide fixation in chloroplasts far exceeds the rate of respiratory carbon dioxide generation in mitochondria. Consequently, all carbon dioxide produced by respiration during daytime is internally recycled and consumed directly in photosynthetic reactions.

168. (C) It takes place in the cytoplasm
Glycolysis is the fundamental ten-step enzymatic pathway occurring within the fluid cytoplasm of all living cells. It operates independently of oxygen, converting one molecule of glucose into two pyruvate molecules with a net output of two ATP, serving as the common initial stage for both aerobic and anaerobic respiration.

169. (C) To prevent tracheal collapse
C-shaped cartilaginous rings in the tracheal wall provide firm structural support while retaining elasticity. During inspiration, expanding thoracic

volume creates negative internal airway pressure relative to the atmosphere. Rigid hyaline cartilage rings prevent tracheal walls from collapsing inward under this pressure differential, maintaining an open airway for continuous respiration.

170. (B) Carbon dioxide
Bread dough rises due to carbon dioxide gas generated during anaerobic fermentation by yeast cells. Yeast metabolizes dough sugars into ethanol and carbon dioxide. As temperature rises during baking, expanding carbon dioxide bubbles become trapped within the elastic gluten matrix, creating the characteristic porous, spongy structure of baked bread.

171. (B) Iron
Haemoglobin, the human respiratory pigment in red blood cells, is a metalloprotein containing four heme groups, each incorporating an essential iron atom. Iron ions reversibly bind oxygen molecules in pulmonary capillaries, forming oxyhaemoglobin and enabling efficient oxygen transport through blood circulation to satisfy tissue metabolic requirements.

172. (A) Tidal volume + IRV + ERV
Vital capacity represents the maximum volume of air an individual can forcibly exhale after a maximal inhalation. Mathematically, it is calculated by summing three distinct physiological pulmonary volumes: normal resting tidal volume, inspiratory reserve volume, and expiratory reserve volume, serving as a primary index of ventilatory capability.

173. (C) ATP
Adenosine triphosphate provides the immediate, direct source of chemical energy required for cellular work. While nutrient molecules like glucose store vast energy reserves, cells cannot use them directly. Metabolic oxidation converts nutrient energy into ATP, whose terminal phosphate bond hydrolysis instantly releases free energy to drive cellular processes.

174. (B) Nutrition supplies glucose oxidized in respiration
Nutrition and respiration are interconnected physiological processes essential for life. Nutrition involves ingestion, digestion, and absorption of food macronutrients, providing glucose to body cells via circulation. Cellular respiration subsequently oxidizes this dietary glucose in the presence of oxygen, synthesizing ATP required to fuel cellular activities.

175. (A) 2, 1, 3
Cellular aerobic respiration initiates in the cytoplasm with glycolysis, breaking glucose down into pyruvate. Pyruvate is then transported into mitochondria for complete oxidation through the Krebs cycle and electron transport chain. This sequential process concludes with the release of carbon dioxide, water, and thirty-eight ATP molecules per glucose.

176. (C) It relaxes into a dome shape
During forceful exhalation, the contracted muscular diaphragm relaxes, returning to its natural upwardly curved dome-shaped position beneath the lungs. Concurrently, internal intercostal muscles depress the rib cage inward, significantly decreasing thoracic cavity volume, elevating internal intrapulmonary pressure, and forcing air out through conducting airways.

177. (B) Earthworms and frogs
Earthworms and frogs demonstrate cutaneous respiration, exchanging gases directly across their moist skin surface. Earthworms rely entirely on cutaneous respiration, while frogs utilize their thin, highly vascularized, mucus-covered skin alongside pulmonary lungs, allowing dissolved environmental oxygen to diffuse directly into subcutaneous capillaries both in water and on land.

178. (B) Roots will die from lack of oxygen
Continuous over-watering fills interstitial air spaces within soil with liquid water, displacing trapped atmospheric oxygen and creating anoxic root conditions. Deprived of oxygen, root cells cannot perform aerobic cellular respiration, halting ATP synthesis. Prolonged oxygen starvation leads to toxic anaerobic metabolite buildup, root decay, and plant death.

179. (A) Simple diffusion down a concentration gradient
Respiratory gas exchange across the alveolar-capillary membrane occurs via simple passive diffusion down partial pressure gradients. Inhaled air maintains higher oxygen partial pressure in alveoli than in deoxygenated venous blood, driving oxygen inward. Conversely, higher carbon dioxide partial pressure in capillary

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blood causes carbon dioxide to diffuse outward into alveoli.

180. (A) I and II
Cellular respiration is a controlled biological process occurring inside living cells, releasing energy in enzymatic steps captured as ATP. Conversely, combustion is a non-cellular, rapid chemical oxidation releasing heat and light instantly without enzymes, making statements I and II accurate distinctions between the two processes.

181. (C) Tracheoles
In insects, gas exchange bypasses the circulatory system completely. Atmospheric air enters external spiracles and flows through branching chitinous tracheal tubes that terminate in fluid-filled microscopic tracheoles. These delicate tracheoles penetrate directly into individual tissues, allowing molecular oxygen to diffuse straight into body cells without blood carrier proteins.

182. (B) It increases blood flow to break down lactic acid
Applying a hot water bath or gentle massage to cramped muscle tissue induces local vasodilation, increasing regional blood circulation. Enhanced blood flow rapidly delivers fresh oxygen to oxygen-starved muscle fibers and facilitates removal of accumulated lactic acid, transporting it to the liver where it is oxidized and metabolized.

183. (A) Chronic bronchitis
Chronic bronchitis is a long-term obstructive pulmonary disorder characterized by chronic bronchial inflammation, excessive thick mucus secretion, persistent productive cough, and shortness of breath. Primarily caused by prolonged exposure to airborne irritants like cigarette smoke, it damages airway lining and cilia, resulting in persistent respiratory impairment.

184. (C) Bronchi
The inferior terminus of the central tracheal windpipe bifurcates at the carina into two primary conducting airways known as the right and left main bronchi. Each primary bronchus enters its respective lung, branching sequentially into smaller secondary bronchi, tertiary bronchi, bronchioles, and ultimately microscopic alveolar clusters.

185. (A) Acclimatization
Rapid increase in breathing rate and depth upon ascending to high altitude represents acclimatization, an immediate physiological compensation for reduced ambient oxygen partial pressure. Over days and weeks, acclimatization also includes increased erythropoietin production, elevated red blood cell counts, and structural vascular changes that optimize systemic oxygen delivery in hypoxic environments.

186. (B) The bond between second and third phosphates
The phosphoanhydride bond linking the second and third terminal phosphate groups in adenosine triphosphate contains high energy readily available for cellular work. Enzymatic hydrolysis of this terminal bond cleaves ATP into ADP and inorganic phosphate, releasing free energy utilized by cellular enzymes to drive endergonic physiological reactions.

187. (B) Mitochondria
Pyruvate breakdown in the presence of oxygen occurs inside eukaryotic mitochondria. Transported into the mitochondrial matrix, pyruvate is converted to acetyl-CoA, entering the Krebs cycle. Subsequent oxidative phosphorylation along inner mitochondrial cristae completely oxidizes pyruvate into carbon dioxide, water, and thirty-eight ATP molecules per original glucose.

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188. (B) Nasal septum
The nasal septum is a central vertical partition dividing the human nasal cavity into symmetrical right and left nasal fossae. Composed of an anterior cartilaginous section and posterior bony structures including the perpendicular plate of the ethmoid and vomer bone, it structurally optimizes airflow and mucosal surface area.

189. (B) It reduces friction during lung movement
Pleural fluid is a serous lubricating fluid secreted into the narrow pleural cavity between visceral and parietal pleural membranes surrounding human lungs. As lungs expand and contract during inspiration and exhalation, pleural fluid minimizes surface friction between moving lung surfaces and chest wall, permitting smooth, painless pulmonary ventilation.

190. (A) I, II, and III
At high altitudes, ambient atmospheric pressure decreases, reducing oxygen partial pressure and causing hypoxia. The body compensates immediately by increasing breathing frequency and long-term by stimulating erythropoiesis to elevate red blood cell counts. Statement IV is incorrect because barometric atmospheric pressure drops with increasing elevation.

191. (B) Both aerobic and anaerobic respiration
During intense exercise, muscular energy expenditure exceeds aerobic oxygen supply capacity. While mitochondria continue performing aerobic respiration at maximum speed, skeletal muscle cells simultaneously activate anaerobic glycolysis, converting excess pyruvate into lactic acid to generate supplementary local ATP required to sustain vigorous muscular contractions.

192. (B) Max air expelled after maximum inhalation
Vital capacity is defined as the maximum volume of air an individual can forcibly expel from lungs following maximal deep inhalation. Measured clinically via spirometry, it encompasses inspiratory reserve volume, tidal volume, and expiratory reserve volume, serving as a primary quantitative measure of functional lung capacity and ventilatory efficiency.

193. (B) Larynx
The larynx, located in the anterior neck superior to the trachea, serves as the primary organ for human phonation. It houses elastic vocal cords that adduct across the laryngeal lumen. Air forced upward from lungs causes these vocal cords to vibrate, producing fundamental sound frequencies modified into speech by articulatory structures.

194. (A) Thoracic volume increases and pressure decreases
Inhalation occurs when contraction of the diaphragm and intercostal muscles expands the thoracic cavity in all dimensions. As thoracic volume increases, internal intrapulmonary pressure drops below atmospheric pressure in accordance with Boyle's law. This pressure gradient causes external air to flow naturally through conducting airways into expanding lungs.

195. (A) P-4, Q-3, R-2, S-1
Aerobic respiration completely breaks down glucose to yield carbon dioxide, water, and thirty-eight ATP. Yeast anaerobic fermentation yields ethanol, carbon dioxide, and minimal ATP, whereas muscle anaerobic respiration produces lactic acid. Photosynthesis utilizes carbon dioxide and water to synthesize glucose sugars and molecular oxygen.

196. (B) Rings of chitin
The tracheal system of insects consists of internal air tubes lined with a tough, flexible polysaccharide called chitin. Spiral thickenings of chitin, known as taenidia, line the inner walls of these tracheal tubes, providing structural reinforcement that prevents airway collapse under body pressure changes and maintains open channels for gas transport.

197. (C) Capillaries
Microscopic air sacs called alveoli are densely wrapped in extensive networks of pulmonary blood capillaries. The walls of both alveoli and capillaries consist of single-cell thin endothelial and epithelial layers, creating a thin respiratory membrane that facilitates rapid passive diffusion of oxygen into blood and carbon dioxide into alveoli.

198. (B) Tar
Cigarette smoke contains a sticky, dark chemical condensate known as tar. When inhaled, tar deposits along respiratory mucosal linings, paralyzing and destroying microscopic ciliated epithelial cells. This loss of ciliary function impairs mucociliary clearance, trapping particulates and mucus, and predisposing lungs to chronic inflammation, bronchitis, and cellular damage.

199. (B) Residual volume
Residual volume is the volume of air remaining in human lungs even after the most forceful maximal exhalation. This residual air cannot be voluntarily expelled and prevents complete collapse of delicate pulmonary alveoli, maintaining continuous arterial gas exchange and stabilizing blood oxygen and carbon dioxide levels between respiratory cycles.

200. (B) Solar energy
Solar energy from the sun is the ultimate energy source locked within glucose molecules. During

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plant photosynthesis, light energy absorbed by chlorophyll drives carbon dioxide fixation into chemical bonds of glucose. Later, cellular respiration breaks these covalent glucose bonds, releasing stored solar chemical energy as ATP to power biological life.

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CHAPTER 03

Transportation

1. Why is simple diffusion insufficient to meet the oxygen requirements of a complex multicellular organism like humans?
(A) Diffusion is a very fast process
(B) Diffusion only occurs in plants
(C) Multicellular organisms do not require oxygen for survival
(D) All cells are not in direct contact with the surrounding environment

2. Which fluid connective tissue is primarily responsible for the transport of oxygen, carbon dioxide, and nutrients in the human body?
(A) Lymph
(B) Water
(C) Blood
(D) Interstitial fluid

3. What is the main function of xylem tissue in higher plants?
(A) Translocation of synthesised food
(B) Transport of water and minerals
(C) Exchange of atmospheric gases
(D) Storage of reserve food

4. In which form is the synthesised food primarily translocated through the phloem in plants?
(A) Glucose
(B) Fructose
(C) Starch
(D) Sucrose

5. The human heart consists of how many chambers to prevent the mixing of oxygenated and deoxygenated blood?
(A) Two
(B) Three
(C) Four
(D) Five

6. Which cellular component of human blood lacks a nucleus at maturity and contains haemoglobin?
(A) White blood cells
(B) Platelets
(C) Red blood cells
(D) Plasma

7. The movement of water molecules from a region of higher water concentration to a region of lower water concentration through a semi-permeable membrane is termed as:
(A) Osmosis
(B) Active transport
(C) Phagocytosis
(D) Transpiration

8. Which blood vessels carry blood away from the heart to various organs of the body?
(A) Veins
(B) Capillaries
(C) Venules
(D) Arteries

9. Identify the incorrect statement regarding veins in the human circulatory system.
(A) They carry blood towards the heart
(B) They have thick, highly elastic walls
(C) They possess valves to prevent backflow
(D) They generally carry deoxygenated blood

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10. Read the following statements of Assertion (A) and Reason (R) and select the correct option.
Assertion (A): The wall of the left ventricle is thicker than the wall of the right ventricle.
Reason (R): The left ventricle has to pump blood to all parts of the body under high pressure.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

11. Which cells in the blood play a major role in defending the body against infections?
(A) Erythrocytes
(B) Thrombocytes
(C) Reticulocytes
(D) Leukocytes

12. What is the process of loss of water in the form of vapour from the aerial parts of a plant called?
(A) Transpiration
(B) Translocation

(C) Respiration
(D) Guttation

13. Which of the following components of blood helps in the coagulation or clotting of blood at the site of a cut?
(A) Red blood cells
(B) Platelets
(C) White blood cells
(D) Plasma proteins only

14. Which structure separates the right atrium from the right ventricle and prevents the backflow of blood?
(A) Bicuspid valve
(B) Tricuspid valve
(C) Semilunar valve
(D) Septum

15. Which of the following represents the correct pathway of water movement from the soil into a plant?
(A) Root hair → Cortex → Endodermis → Xylem
(B) Root hair → Endodermis → Cortex → Xylem
(C) Epidermis → Xylem → Cortex → Endodermis
(D) Cortex → Root hair → Xylem → Endodermis

16. In the human circulatory system, which vessel brings oxygenated blood from the lungs to the left atrium?
(A) Pulmonary artery
(B) Aorta
(C) Pulmonary vein
(D) Vena cava

17. The phenomenon of double circulation in humans comprises which two circulatory pathways?
(A) Arterial and venous circulation
(B) Hepatic and portal circulation
(C) Lymphatic and blood circulation
(D) Systemic and pulmonary

18. What is the normal resting blood pressure of a healthy human adult?
(A) 80/120 mm Hg
(B) 100/60 mm Hg
(C) 120/80 mm Hg
(D) 140/90 mm Hg

19. Which instrument is commonly used by doctors to measure human blood pressure?
(A) Stethoscope
(B) Sphygmomanometer
(C) Thermometer
(D) Barometer

20. Match List I with List II and select the correct option.
List I: (Blood Vessel)
P. Aorta
Q. Vena Cava
R. Pulmonary Artery
S. Capillaries
List II: (Characteristic)
1. Smallest vessels for material exchange
2. Carries deoxygenated blood to the lungs
3. Largest artery carrying oxygenated blood
4. Largest vein carrying deoxygenated blood
(A) P-3, Q-4, R-2, S-1
(B) P-4, Q-3, R-1, S-2
(C) P-3, Q-2, R-4, S-1
(D) P-1, Q-4, R-2, S-3

21. Lymph differs from blood in that it primarily lacks which of the following?
(A) White blood cells
(B) Water
(C) Dissolved nutrients
(D) Red blood cells

22. What causes the continuous ascent of sap in tall trees during the daytime?
(A) Transpiration pull
(B) Root pressure only
(C) Active transport by phloem
(D) Capillary action only

23. What is the liquid matrix of blood called?
(A) Serum
(B) Lymph
(C) Plasma
(D) Tissue fluid

24. Which individual is considered a universal donor in the ABO blood group system?
(A) Blood group O
(B) Blood group A
(C) Blood group B
(D) Blood group AB

25. Which mineral is an essential component of haemoglobin for the transport of oxygen?
(A) Calcium
(B) Magnesium
(C) Iron
(D) Phosphorus

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26. A deficiency of haemoglobin or red blood cells in the human body leads to a condition known as:
(A) Leukaemia
(B) Anaemia
(C) Haemophilia
(D) Hypertension

27. The transport of soluble products of photosynthesis in plants is achieved using energy in the form of ATP. This is an example of:
(A) Simple diffusion
(B) Passive transport
(C) Osmosis
(D) Active transport

28. Which structures in the leaf allow the process of transpiration and exchange of gases to occur?
(A) Stomata
(B) Lenticels
(C) Hydathodes
(D) Root hairs

29. The phase of contraction of the heart chambers is medically termed as:
(A) Diastole
(B) Pacemaker
(C) Systole
(D) Fibrillation

30. Consider the following statements regarding the human heart:
I. The right atrium receives deoxygenated blood from the body.
II. The left atrium receives oxygenated blood from the lungs.
III. The right ventricle pumps oxygenated blood to the body.
Which of the given statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

31. Which of the following plant tissues contains dead cells at maturity that facilitate water transport?
(A) Phloem sieve tubes
(B) Companion cells
(C) Palisade parenchyma
(D) Xylem vessels

32. In human beings, how many times does blood flow through the heart during one complete cycle?
(A) Once
(B) Twice
(C) Thrice
(D) Four times

33. Identify the odd one out with respect to the components of phloem tissue.
(A) Sieve tubes
(B) Companion cells
(C) Tracheids
(D) Phloem parenchyma

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34. What happens when the stomata of a leaf close during the night?
(A) Photosynthesis rate increases
(B) Transpiration stops completely
(C) Root pressure becomes zero
(D) Phloem transport reverses direction

35. Arrange the following parts of the human circulatory system in the correct sequence for a red blood cell travelling from the lungs to the body tissues:
I. Aorta
II. Left atrium
III. Left ventricle
IV. Pulmonary vein
Which of the following is the correct sequence?
(A) IV, II, III, I
(B) IV, III, II, I
(C) II, III, IV, I
(D) I, II, III, IV

36. Which network of extremely narrow blood vessels connects arteries and veins?
(A) Capillaries
(B) Vena cava
(C) Aorta
(D) Lymph vessels

37. Which of the following is the main force responsible for the movement of water up a tall tree during the night?
(A) Transpiration pull
(B) Cohesion-tension
(C) Gravity
(D) Root pressure

38. The Rh factor is an antigen first discovered in which organism?
(A) Rhesus monkey
(B) European rabbit
(C) Laboratory rat
(D) African rhinoceros

39. Which of the following is not a function of the lymphatic system?
(A) Transporting digested and absorbed fats
(B) Draining excess interstitial fluid back to the blood
(C) Transporting oxygen to brain cells
(D) Fighting infections by producing lymphocytes

40. Consider the following statements regarding blood pressure:
I. Systolic pressure is normally around 120 mm Hg.
II. Diastolic pressure is normally around 80 mm Hg.
III. High blood pressure is called hypertension.
IV. Blood pressure is measured in the veins.
Which of the given statements are correct?
(A) I, II, and III only
(B) II, III, and IV only
(C) I, III, and IV only
(D) I, II, III, and IV

41. The condition in which an artery gets blocked by a blood clot or plaque, reducing blood supply to the heart muscle, leads to:
(A) Heart attack
(B) Acute leukaemia
(C) Obstructive jaundice
(D) Iron-deficiency anaemia

42. What drives the initial entry of water from the soil into the root hair cells?
(A) Transpiration pull
(B) Osmosis
(C) Plasmolysis
(D) Active pumping by leaves

43. Which of the following best describes the principle of the "cohesion-tension theory" in plants?
(A) Active transport of sugars generates osmotic force to push xylem sap
(B) Water molecules cohere and are pulled upward by transpiration
(C) Root epidermal cells actively pump continuous water columns against gravity
(D) Phloem sieve tubes utilize cellular ATP energy to lift sap upward

44. What happens when blood platelets encounter a site of injury?
(A) They actively synthesize and secrete specific antibodies
(B) They initiate the blood clotting process
(C) They engulf and destroy invading pathogenic bacteria
(D) They transport extra dissolved oxygen to the damaged tissue

45. In the final step of blood clotting, which soluble plasma protein is converted into an insoluble meshwork?
(A) Prothrombin
(B) Albumin
(C) Fibrinogen
(D) Globulin

46. During the purification of blood, carbon dioxide is removed in which organ before the blood returns to the heart?
(A) Kidneys
(B) Lungs
(C) Liver
(D) Spleen

47. Which blood group is known as the universal recipient?
(A) A
(B) B
(C) O
(D) AB

48. The normal resting heart rate of a healthy adult human is approximately:
(A) 40-50 beats per minute
(B) 70-80 beats per minute
(C) 100-110 beats per minute
(D) 120-130 beats per minute

49. Why do ventricles have thicker muscular walls than atria?
(A) To store larger volumes of blood during the resting diastole phase
(B) To pump blood to various organs at high pressure
(C) Because they continuously receive incoming blood directly from major veins
(D) To shield internal heart structures from external mechanical shocks

50. Read the following statements of Assertion (A) and Reason (R) and select the correct option.
Assertion (A): Transpiration is a necessary evil for plants.
Reason (R): Transpiration causes loss of water but helps in temperature regulation and ascent of sap.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.

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(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

51. The transport of which of the following substances through the phloem requires the use of energy (ATP)?
(A) Water
(B) Mineral salts
(C) Oxygen
(D) Sucrose

52. When the osmotic pressure inside the phloem tissue increases due to the active loading of food, what happens next?
(A) Water moves from xylem into phloem by osmosis
(B) The specialized phloem sieve elements undergo sudden cell death
(C) The dissolved sugar immediately converts into insoluble starch grains
(D) Excess cellular fluid is forcefully expelled directly into air spaces

53. The interrelation between the transport system and the excretory system is best observed in which organ where blood is filtered to remove urea?
(A) Lungs
(B) Kidneys
(C) Heart
(D) Liver

54. Identify the correct pair representing a component of blood and its primary function.
(A) Red blood cells - Initiation of blood clotting mechanisms
(B) White blood cells - Respiratory transport of oxygen gas
(C) Plasma - Transport of nutrients and hormones
(D) Platelets - Defense against systemic bacterial infections

55. Which of the following represents the correct order of chambers through which deoxygenated blood flows in the human heart?
(A) Right atrium → Right ventricle → Pulmonary artery → Lungs
(B) Right atrium → Left atrium → Right ventricle → Lungs
(C) Left atrium → Left ventricle → Aorta → Body
(D) Right ventricle → Right atrium → Vena cava → Body

56. The pulse rate is directly a measure of the:
(A) Breathing rate of the lungs
(B) Rate of digestion
(C) Heartbeats per minute
(D) Rate of urine formation

57. High blood pressure in humans is technically referred to as:
(A) Hypotension
(B) Hypertension
(C) Hyperglycemia
(D) Anaemia

58. Which of the following structures act as a 'sink' during the translocation of food in plants in the summer?
(A) Mature photosynthetic leaves
(B) Old, yellowing leaves
(C) Dead xylem vessels
(D) Growing fruits and roots

59. What prevents the backflow of blood inside the heart during ventricular contraction?
(A) Thick walls of the ventricles
(B) High pressure in the atria
(C) Valves present in the heart
(D) The pericardium membrane

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60. Match List I with List II and select the correct option.
List I: (Process)
P. Transpiration
Q. Translocation
R. Osmosis
S. Diffusion
List II: (Description)
1. Movement of water across a semi-permeable membrane
2. Loss of water vapour from leaves
3. Transport of soluble food in plants
4. Movement of gases from high to low concentration
(A) P-2, Q-3, R-1, S-4
(B) P-3, Q-2, R-4, S-1
(C) P-1, Q-4, R-2, S-3
(D) P-2, Q-1, R-3, S-4

61. The process of diffusion differs from osmosis in that diffusion:
(A) Requires an intact semi-permeable membrane to proceed
(B) Directly utilizes cellular ATP energy during

transport
(C) Occurs in any medium without a membrane
(D) Exclusively involves the passive movement of water molecules

62. The continuous circulation cycle in the body relies on the heart acting as a:
(A) Filter
(B) Storage organ
(C) Gas exchange surface
(D) Pumping organ

63. Which part of the blood consists of about 90% water and 10% dissolved substances like proteins, salts, and nutrients?
(A) Plasma
(B) Lymphocytes
(C) Erythrocytes
(D) Platelets

64. What is the role of the septum in the human heart?
(A) It continuously generates autonomic electrical impulses for regular heartbeats
(B) It firmly attaches the external heart walls to the surrounding rib cage
(C) It opens periodically to allow direct blood flow from ventricles into atria
(D) It keeps oxygenated and deoxygenated blood separate

65. In which direction does xylem predominantly transport water and minerals?
(A) Simultaneously in both upward and downward directions
(B) Unidirectionally from roots to leaves
(C) Laterally across stem branches directly from mature leaves
(D) Bidirectionally throughout plant organs depending on season

66. How does the structure of veins differ from that of arteries to suit their function?
(A) Veins possess significantly thicker and more muscular structural walls
(B) Veins completely lack an internal endothelial cell lining layer
(C) Veins continuously carry circulating blood under much higher pressure
(D) Veins possess valves that prevent backflow

67. The thick, muscular wall separating the right and left sides of the human heart is called the:
(A) Septum
(B) Myocardium
(C) Pericardium
(D) Endocardium

68. Which of the following best defines systemic circulation?
(A) Deoxygenated blood flow traveling from the heart to lungs and back
(B) Specialized blood flow restricted strictly within internal heart chambers
(C) Continuous active movement of water and organic nutrients in plants
(D) Blood circulation between the heart and body tissues

69. Which component of the diet is most critical to prevent iron-deficiency anaemia?
(A) Vitamin C
(B) Calcium
(C) Iron
(D) Carbohydrates

70. Consider the following statements about the lymphatic system:
I. Lymph contains less protein than blood plasma.
II. Lymph flows from the tissues towards the heart.
III. Lymph nodes produce red blood cells.
Which of the given statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

71. Blood pressure is expressed as two numbers. The higher number indicates the pressure when the ventricles contract, known as:
(A) Diastolic pressure
(B) Pulse pressure
(C) Venous pressure
(D) Systolic pressure

72. Which of the following blood groups contains both anti-A and anti-B antibodies in its plasma?
(A) O
(B) A
(C) B
(D) AB

73. Which feature is unique to phloem compared to xylem?
(A) It continuously carries dissolved inorganic mineral salts and water
(B) Transport is bidirectional based on plant needs

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(C) It relies primarily on passive forces generated by transpiration pull
(D) It is structurally composed entirely of non-living dead cell types

74. How does the plant use root pressure in the transport of water?
(A) It acts as the primary force driving sap to the topmost branches of tall trees
(B) It completely stops surrounding soil water from entering root tissue layers
(C) It actively pushes translocated sugars outward into the surrounding soil profile
(D) It helps re-establish continuous water columns in the xylem

75. Which type of blood cells are also known as erythrocytes?
(A) White blood cells
(B) Platelets
(C) Red blood cells
(D) Lymphocytes

76. During heavy physical exercise, the heart rate increases primarily to:
(A) Decrease blood pressure
(B) Supply more oxygen and glucose to the muscles
(C) Reduce the amount of carbon dioxide in the blood instantly
(D) Cool down the body temperature

77. The process of blood purification involves filtering nitrogenous waste. Which organs perform this continuous filtration from the bloodstream?
(A) Lungs
(B) Intestines
(C) Pancreas
(D) Kidneys

78. What happens to the rate of transpiration on a hot, sunny, and windy day?
(A) It increases
(B) It decreases significantly
(C) It remains unchanged
(D) It stops entirely

79. Identify the correct exception: All arteries carry oxygenated blood EXCEPT the:
(A) Systemic aorta
(B) Coronary artery
(C) Pulmonary artery
(D) Systemic renal artery

80. Consider the following statements about transpiration:
I. It creates a suction force that pulls water upwards.
II. It helps in cooling the plant.
III. It transports sugars from leaves to roots.
IV. It primarily occurs through stomata.
Which of the given statements are correct?
(A) I, II, and IV only
(B) II, III, and IV only
(C) I, III, and IV only
(D) I, II, III, and IV

81. Which component of the heart regulates the unidirectional flow of blood from the left atrium into the left ventricle?
(A) Tricuspid valve
(B) Pulmonary semilunar valve
(C) Aortic semilunar valve
(D) Bicuspid valve

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82. The term 'Source' in the source-sink mechanism of plant transport typically refers to:
(A) Photosynthetic leaves
(B) Root hairs absorbing soil water
(C) Reproductive flowers producing pollen
(D) Outer bark tissue storing waste products

83. The major structural difference between capillaries and other blood vessels is that capillaries:
(A) Have very thick muscular walls
(B) Consist of a single layer of cells
(C) Always carry deoxygenated blood
(D) Contain valves to prevent backflow

84. Which of the following symptoms is most commonly associated with severe anaemia?
(A) Sustained high fever and chills
(B) Rapid, unexplained weight gain
(C) Severe yellowing of skin and eyes
(D) Fatigue and weakness

85. Arrange the following steps of water transport in a plant in the correct sequence:
I. Water evaporates from the stomata (Transpiration).
II. Tension is created in the xylem vessels.
III. Water is absorbed by the root hairs.
IV. Water is pulled upwards through the stem.
Which of the following is the correct sequence?
(A) III, I, II, IV
(B) I, II, IV, III
(C) III, IV, II, I

(D) I, IV, II, III

86. What is the protective double-layered membranous sac that encloses the human heart?
(A) Pleura
(B) Meninges
(C) Pericardium
(D) Peritoneum

87. In the context of blood groups, a person with Rh-positive (Rh+) blood:
(A) Has the Rh antigen on their red blood cells
(B) Lacks the Rh antigen on their red blood cells
(C) Can only receive blood from an Rh-negative donor
(D) Does not have any blood group antigens

88. The transportation of manufactured food from the leaves to other parts of the plant is technically known as:
(A) Transpiration
(B) Respiration
(C) Guttation
(D) Translocation

89. Which property of water molecules allows them to stick to each other, forming a continuous column in the xylem?
(A) Adhesion
(B) Evaporation
(C) Cohesion
(D) Sublimation

90. Read the following statements of Assertion (A) and Reason (R) and select the correct option.
Assertion (A): Veins have thin walls compared to arteries.
Reason (R): Blood in veins is no longer under high pressure.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

91. The pulse rate is most commonly measured by placing the fingers over an artery at which location on the human body?
(A) The upper region of the chest
(B) Wrist or neck
(C) The anterior abdominal wall
(D) The central forehead region

92. Identify the incorrect pair regarding the human transport system.
(A) Pulmonary artery - Carries deoxygenated blood
(B) Vena Cava - Carries oxygenated blood
(C) Aorta - Carries oxygenated blood
(D) Pulmonary vein - Carries oxygenated blood

93. What is the primary role of the lymphatic system in maintaining fluid balance?
(A) Actively pumping blood toward peripheral body extremities
(B) Draining excess fluid back to blood
(C) Producing new red blood cells within lymphatic nodes
(D) Continuously filtering metabolic urine wastes from blood

94. A person's blood pressure is recorded as 145/95 mm Hg. This reading indicates that the person is likely suffering from:
(A) Hypotension
(B) Normal blood pressure
(C) Anaemia
(D) Hypertension

95. What drives the movement of food through the phloem sieve tubes according to the pressure-flow hypothesis?
(A) Capillary action in vessel walls
(B) Osmotic pressure
(C) Transpiration pull from leaves
(D) Wind movement around branches

96. Which component of the blood carries carbon dioxide in the dissolved form back to the lungs?
(A) Blood platelets
(B) Lymphocytes
(C) Plasma
(D) Eosinophils

97. During blood clotting, the enzyme thrombin catalyzes the conversion of which soluble protein into insoluble threads?
(A) Fibrinogen
(B) Albumin
(C) Globulin
(D) Haemoglobin

98. In plants, the transport of water and dissolved minerals is:
(A) Bidirectional
(B) Unidirectional
(C) Multidirectional
(D) Non-directional

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99. Which of the following environmental factors decreases the rate of transpiration in plants?
(A) High temperature
(B) High wind speed
(C) High light intensity
(D) High humidity

100. Match List I with List II and select the correct option.
List I: (Blood Group Concept)
P. Blood Group A
Q. Blood Group O
R. Rh Factor
S. Haemoglobin
List II: (Description)
1. Universal donor
2. Antigen first found in a monkey
3. Has Antigen A on red blood cells
4. Respiratory pigment in red blood cells
(A) P-3, Q-1, R-2, S-4
(B) P-1, Q-3, R-2, S-4
(C) P-3, Q-2, R-1, S-4
(D) P-2, Q-1, R-4, S-3

101. Which organ of the human body is primarily responsible for the pumping of blood?
(A) Liver
(B) Brain
(C) Heart
(D) Lungs

102. When measuring blood pressure with a sphygmomanometer, the cuff is generally wrapped around the:
(A) Upper arm
(B) Forearm region
(C) Radial wrist
(D) Lower thigh

103. Which set of structures constitutes the transporting tissue in plants?
(A) Epidermis and cortex
(B) Parenchyma and collenchyma
(C) Xylem and phloem
(D) Cambium and pith

104. Which blood cells lack a nucleus in humans to provide more space for haemoglobin?
(A) White blood cells
(B) Platelets
(C) Macrophages
(D) Red blood cells

105. Which of the following represents the correct sequence of blood flow from the heart to the body and back?
(A) Heart → Veins → Capillaries → Arteries → Heart
(B) Heart → Arteries → Capillaries → Veins → Heart
(C) Heart → Capillaries → Veins → Arteries → Heart
(D) Heart → Arteries → Veins → Capillaries → Heart

106. What is the function of the bicuspid and tricuspid valves in the heart?
(A) To actively push systemic blood forward into the lungs
(B) To mix oxygenated and deoxygenated blood inside chambers
(C) To autonomously regulate the overall cardiac resting rate
(D) To prevent backflow from ventricles into atria

107. Which of the following best defines the process of active transport in plants?
(A) Movement of molecules against a gradient using ATP
(B) Passive movement of solute molecules down a steep concentration gradient
(C) Continuous physical evaporation of water molecules through leaf stomata
(D) Spontaneous physical mixing of respiratory gases within leaf tissues

108. The largest artery in the human body that carries oxygenated blood from the left ventricle is the:
(A) Pulmonary artery
(B) Vena cava
(C) Renal artery
(D) Aorta

109. Which structural adaptation allows capillaries to facilitate the exchange of materials between blood and tissues?
(A) They have thick elastic walls
(B) They contain valves
(C) Their walls are one cell thick
(D) They carry high-pressure blood

110. Consider the following statements about blood groups:
I. A person with AB blood group has both A and B antigens.

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II. A person with O blood group has neither A nor B antigens.
III. Blood group O is considered the universal recipient.
Which of the given statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

111. Lymph capillaries in the intestinal villi, which absorb digested fats, are specifically called:
(A) Venules
(B) Arteries
(C) Lymph nodes
(D) Lacteals

112. The term "double circulation" in humans refers to which two pathways?
(A) Pulmonary and Systemic
(B) Hepatic and Renal
(C) Arterial and Venous
(D) Oxygenated and Deoxygenated

113. Water absorption by plant roots from the soil occurs primarily through which physical process?
(A) Transpiration
(B) Osmosis
(C) Cohesion
(D) Adhesion

114. Which structure prevents the mixing of oxygen-rich blood and carbon dioxide-rich blood in the human heart?
(A) Pericardium
(B) Septum
(C) Valves
(D) Atria

115. A diet severely deficient in iron will most directly impact the blood's ability to:
(A) Transport oxygen
(B) Form clots
(C) Fight infections
(D) Regulate temperature

116. Phloem tissue in higher plants consists of which two main types of living cells involved in transport?
(A) Tracheids and xylem vessel elements
(B) Sieve tubes and companion cells
(C) Phloem parenchyma and collenchyma
(D) Outer epidermis and inner endodermis

117. High blood pressure can lead to the rupture of blood vessels and internal bleeding. This condition is dangerous because it damages:
(A) Only the superficial epithelial skin layers
(B) The skeletal framework and bone tissue
(C) Only the lower gastrointestinal digestive tract
(D) Vital organs like brain and kidneys

118. What is the effect of root pressure on water transport in plants?
(A) It acts as the principal driving force pulling water columns in tall trees
(B) It pushes water to modest heights and aids guttation
(C) It causes stomatal closure and stops transpiration completely
(D) It actively transports translocated food downward to root organs

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119. In the human heart, oxygenated blood from the lungs enters the:
(A) Right atrium
(B) Left atrium
(C) Right ventricle
(D) Left ventricle

120. Consider the following statements about white blood cells (WBCs):
I. They are also known as leukocytes.
II. They contain haemoglobin.
III. They are part of the body's immune system.
IV. They are generally larger than red blood cells.
Which of the given statements are correct?
(A) I, II, and III only
(B) I, III, and IV only
(C) II, III, and IV only
(D) I, II, and IV only

121. The fluid part of the blood without the clotting factors is known as:
(A) Lymph
(B) Plasma
(C) Interstitial fluid
(D) Serum

122. Which part of the brain is indirectly monitored when we say the heart beats involuntarily due to intrinsic nervous control?
(A) Cerebrum
(B) Cerebellum
(C) Medulla oblongata
(D) Hypothalamus

123. If a patient is diagnosed with severe anaemia, a blood test would most likely reveal a low count of:
(A) Platelets
(B) Red blood cells
(C) White blood cells
(D) Lymphocytes

124. How does transpiration assist in the transport of water in plants?
(A) It pushes water downwards from the leaves
(B) It provides ATP for active transport of water
(C) It closes stomata to trap water inside
(D) It generates a strong upward pull or tension

125. The transport of food from the leaves to other parts of the plant through the phloem is called:
(A) Translocation
(B) Respiration
(C) Transpiration
(D) Evaporation

126. Which set of components is responsible for the coagulation of blood?
(A) Erythrocytes and haemoglobin
(B) Platelets and fibrin
(C) Leukocytes and antibodies
(D) Blood plasma and fluid serum

127. The normal range of the human pulse rate in a resting adult is:
(A) 40-50 per minute
(B) 60-100 per minute
(C) 110-130 per minute
(D) 130-150 per minute

128. What is the role of semi-lunar valves in the human heart?
(A) To prevent backflow into ventricles from arteries
(B) To prevent blood from flowing back into the atria from the ventricles
(C) To completely separate the right and left sides of the human heart
(D) To firmly attach the heart muscle wall to the thoracic chest cavity

129. Identify the correct statement regarding xylem.
(A) Xylem transports food downwards
(B) Xylem cells are mostly living
(C) Xylem requires energy in the form of ATP for water transport
(D) Xylem transports water and minerals upwards

130. Read the following statements of Assertion (A) and Reason (R) and select the correct option.
Assertion (A): The left atrium receives oxygenated blood from the lungs.
Reason (R): The pulmonary artery carries oxygenated blood to the left atrium.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

131. Which of the following is a major cause of hypertension (high blood pressure) in humans?
(A) Severe and excessive loss of circulating blood volume
(B) Arteriole constriction increasing resistance
(C) Chronic nutritional lack of dietary iron intake
(D) Abnormal overproduction of erythrocyte red blood cells

132. The primary sink for the food synthesized by leaves during the active fruiting season of a plant is the:
(A) Extensive root system
(B) Mature and old leaves
(C) Outer stem bark layer
(D) Growing fruits

133. Which component of the circulatory system contains nodes that filter foreign particles and bacteria?
(A) Systemic arterial system
(B) Lymph system
(C) Systemic venous system
(D) Hepatic portal system

134. Diffusion is an important process in plants for:
(A) Active water absorption from root hairs
(B) Continuous ascent of sap in xylem
(C) Translocation of dissolved sugars
(D) Gas exchange in leaves

135. Why is the blood circulating in the human body considered "double circulation"?
(A) Blood passes through the heart twice per cycle
(B) Because the human heart is divided internally into four distinct chambers
(C) Because circulating blood consists of two main types of cellular elements
(D) Because blood continuously flows through

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both systemic arteries and veins

136. What is the function of the mesh-like network formed by fibrin during blood clotting?
(A) It actively stimulates bone marrow to produce platelets
(B) It traps blood cells to stop bleeding
(C) It directly delivers dissolved oxygen gas to the wound site
(D) It actively destroys invading pathogenic bacteria at injury sites

137. Which term describes the relaxation phase of the heart cycle?
(A) Systole
(B) Diastole
(C) Tachycardia
(D) Bradycardia

138. Which blood vessel carries deoxygenated blood from the body tissues back to the right atrium of the heart?
(A) Aorta
(B) Pulmonary artery
(C) Vena cava
(D) Pulmonary vein

139. In a tall tree, which process contributes most significantly to the upward movement of water?
(A) Continuous root pressure
(B) Passive cellular osmosis
(C) Transpiration
(D) ATP-driven active transport

140. Match List I with List II and select the correct option.
List I: (Heart Part)
P. Right Atrium
Q. Left Ventricle
R. Septum
S. Pulmonary Artery
List II: (Function)
1. Pumps oxygenated blood to the body
2. Receives deoxygenated blood from the body
3. Carries deoxygenated blood to the lungs
4. Prevents mixing of oxygenated and deoxygenated blood
(A) P-2, Q-1, R-4, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-4, Q-3, R-2, S-1
(D) P-2, Q-4, R-1, S-3

141. The condition known as a heart attack occurs when:
(A) Blood pressure drops suddenly
(B) Red blood cells fail to carry oxygen to the brain
(C) The blood supply to the heart muscle is blocked
(D) The lymphatic vessels get blocked

142. A person with an Rh-negative (Rh-) blood group can safely receive blood from:
(A) An Rh-negative donor only
(B) An Rh-positive donor only
(C) Both Rh-positive and Rh-negative donors
(D) No one

143. During the process of osmosis, water moves across a semi-permeable membrane from a region of:
(A) Higher solute concentration to lower solute concentration
(B) Higher water concentration to lower water concentration
(C) Lower water concentration to higher water concentration
(D) Lower solvent concentration to higher solvent concentration

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144. Which of the following best describes plasma?
(A) Pale yellow fluid containing water and solutes
(B) A specialized solid dense tissue composed strictly of adipose fat cells
(C) The primary protein pigment carrying oxygen gas within red blood cells
(D) The extracellular fluid flowing exclusively inside isolated lymph vessels

145. What happens when the pressure inside the root xylem increases due to continuous water absorption by roots?
(A) Transpiration pull instantly ceases throughout the plant
(B) Water continuously leaks outward from root cells into soil
(C) The aerial parts of the plant wilt and collapse immediately
(D) Root pressure pushes water upward slightly

146. Which of the following acts as the primary transport medium for carbon dioxide, digested food, and nitrogenous wastes in the human body?
(A) Plasma
(B) Haemoglobin
(C) Lymph nodes
(D) Platelets

147. A sphygmomanometer is typically used in conjunction with which other medical instrument to measure blood pressure?
(A) Thermometer
(B) Stethoscope
(C) Electrocardiogram
(D) Endoscope

148. Which component is absent in a mature mammalian red blood cell?
(A) Cell membrane
(B) Cytoplasm
(C) Haemoglobin
(D) Nucleus

149. The movement of food in the phloem is achieved by:
(A) Passive movement through simple diffusion mechanisms only
(B) Osmotic gradients created by active loading
(C) Tension forces generated by continuous transpiration pull
(D) Physical forces resulting from narrow capillary action

150. Consider the following statements about the circulatory system:
I. Arteries are thick-walled because they carry high-pressure blood.
II. Capillaries have valves to prevent backflow.
III. Veins collect blood from different organs and bring it back to the heart.
Which of the given statements is/are correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II and III

151. Why does the right ventricle have thinner walls than the left ventricle?
(A) It continuously receives much smaller volumes of incoming blood
(B) It strictly holds deoxygenated venous blood from systemic body circulation
(C) It functions as a passive holding chamber and does not actively pump blood
(D) It pumps blood only to nearby lungs

152. Which biological process is essential for the upward movement of sap, cooling of the plant, and absorption of minerals?
(A) Transpiration
(B) Respiration
(C) Photosynthesis
(D) Reproduction

153. What is the main cause of the "lub-dub" sound of a beating human heart?
(A) Flow of blood through the arteries
(B) The closing of the heart valves
(C) The expansion of the lungs
(D) The friction of blood against vessel walls

154. If a patient's blood fails to clot effectively after a small cut, they most likely have a deficiency of:
(A) Red blood cells
(B) White blood cells
(C) Haemoglobin
(D) Platelets

155. Which of the following best represents the relationship between the excretory system and the transport system?
(A) The blood transports concentrated liquid urine directly from bladder to kidneys
(B) Blood carries metabolic wastes like urea to kidneys for filtration
(C) The structural kidneys actively pump systemic blood throughout the human body
(D) The lymphatic system continuously filters solid metabolic wastes into intestines

156. The loss of water in the form of liquid droplets from the margins of certain leaves is called guttation. This is primarily caused by:
(A) High suction force generated by active transpiration pull
(B) Extreme atmospheric heat occurring during mid-afternoon hours
(C) Complete stomatal closure taking place in hot, dry weather
(D) Root pressure at night or early morning

157. Which type of white blood cell is primarily involved in producing antibodies to fight infections?
(A) Lymphocytes
(B) Erythrocytes
(C) Thrombocytes
(D) Hepatocytes

158. The transport of sucrose into the phloem tissue from the leaf cells requires:
(A) Only sunlight
(B) Tension from transpiration
(C) Dead xylem cells
(D) Energy in the form of ATP

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159. In the ABO blood group system, the presence or absence of specific proteins on the surface of red blood cells determines the blood type. These proteins are called:
(A) Antibodies
(B) Antigens
(C) Hormones
(D) Enzymes

160. Consider the following statements about blood vessels:
I. Arteries do not have valves.
II. Veins carry blood towards the heart.
III. Capillaries allow exchange of materials across their walls.
IV. All arteries carry oxygenated blood without exception.
Which of the given statements are correct?
(A) I, II, and III only
(B) I, III, and IV only
(C) II, III, and IV only
(D) I, II, III, and IV

161. A doctor feels your pulse by pressing lightly on the inside of your wrist. The vessel they are pressing on is an:
(A) Vein
(B) Capillary
(C) Lymphatic vessel
(D) Artery

162. How does the structure of phloem differ functionally from xylem?
(A) Phloem transport is bidirectional, while xylem transport is unidirectional
(B) Phloem transports only water, while xylem transports food
(C) Phloem is made entirely of dead cells, while xylem is made entirely of living cells
(D) Phloem relies on transpiration pull, while xylem relies on ATP

163. The primary force that pulls water up into the leaves of a tall tree is created by:
(A) Active hydrostatic pumping by deep root tissues
(B) Water evaporation at stomata
(C) Continuous downward flow of food in phloem tissue
(D) Physical wind force blowing against main trunk walls

164. What is the liquid that escapes from blood capillaries into the intercellular spaces called?
(A) Blood plasma
(B) Blood serum
(C) Cell cytoplasm
(D) Tissue fluid

165. The left atrium of the human heart receives:
(A) Deoxygenated blood from the body
(B) Deoxygenated blood from the lungs
(C) Oxygenated blood from the body
(D) Oxygenated blood from the lungs

166. A diet lacking in which nutrient leads to a reduction in the oxygen-carrying capacity of blood?
(A) Vitamin D
(B) Iron
(C) Iodine
(D) Calcium

167. Which term describes the transport system that carries blood from the heart to the lungs and back?
(A) Systemic circulation
(B) Hepatic portal circulation
(C) Coronary circulation
(D) Pulmonary circulation

168. Translocation of food in plants takes place in:
(A) Exclusively in an upward direction toward leaves
(B) Exclusively in a downward direction toward roots
(C) Both upward and downward directions
(D) Exclusively in horizontal lateral directions

169. What is the role of the enzyme thromboplastin in the blood clotting process?
(A) It directly turns soluble fibrin back into fibrinogen
(B) Converts prothrombin to active thrombin
(C) It rapidly dissolves existing cross-linked blood clots
(D) It delivers bound oxygen gas directly to the injury wound

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170. Read the following statements of Assertion (A) and Reason (R) and select the correct option.
Assertion (A): Veins contain valves along their length.
Reason (R): Valves ensure that the blood flows in one direction only, towards the heart.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.

(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

171. The continuous network of fluid-filled tubes that transport water in plants is formed by:
(A) Sieve tubes and companion cells
(B) Stomata and guard cells
(C) Cortex and endodermis
(D) Tracheids and vessels

172. Which of the following is true about blood plasma?
(A) Liquid medium suspending blood cells
(B) It constitutes roughly 10% of the overall total blood volume
(C) It exhibits a deep red color due to dissolved haemoglobin
(D) It is an entirely pure water solution containing no proteins

173. What is the immediate effect if the stomata of a plant are blocked with petroleum jelly?
(A) Atmospheric transpiration rates will dramatically increase
(B) Water transport will drastically decrease
(C) Organic phloem transport will become strictly unidirectional
(D) Internal root pressure force will immediately triple in magnitude

174. Which process allows oxygen to move from the alveoli of the lungs into the blood capillaries?
(A) Osmosis
(B) Active transport
(C) Phagocytosis
(D) Diffusion

175. Arrange the following parts in the correct sequence for the flow of deoxygenated blood:
I. Vena Cava
II. Right Atrium
III. Right Ventricle
IV. Pulmonary Artery
Which of the following is the correct sequence?
(A) I, II, III, IV
(B) II, III, I, IV
(C) IV, III, II, I
(D) I, III, II, IV

176. Which of the following represents the correct combination of a person's blood group and the antibodies present in their blood plasma?
(A) Group A - Anti-A antibodies
(B) Group B - Anti-B antibodies
(C) Group O - Both Anti-A and Anti-B antibodies
(D) Group AB - Both Anti-A and Anti-B antibodies

177. The pressure exerted by blood against the wall of a vessel is highest in the:
(A) Veins
(B) Capillaries
(C) Lymph vessels
(D) Arteries

178. What is the major functional difference between the transport mechanisms of xylem and phloem?
(A) Xylem relies on physical forces; phloem requires active energy (ATP)
(B) Xylem transport is entirely bidirectional, whereas phloem transport is strictly unidirectional
(C) Xylem primarily transports organic sugars, whereas phloem transports inorganic water and minerals
(D) Xylem requires cellular energy (ATP), whereas phloem transport is a purely passive process

179. The blood vessel that supplies oxygenated blood to the heart muscle itself is the:
(A) Pulmonary artery
(B) Coronary artery
(C) Hepatic artery
(D) Renal artery

180. Match List I with List II and select the correct option.
List I: (Term)
P. Systole
Q. Diastole
R. Pulse
S. Sphygmomanometer
List II: (Definition)
1. Relaxation phase of the heart
2. Instrument to measure blood pressure
3. Contraction phase of the heart
4. Throbbing of an artery due to blood flow
(A) P-3, Q-1, R-4, S-2
(B) P-1, Q-3, R-2, S-4
(C) P-3, Q-2, R-1, S-4
(D) P-4, Q-1, R-3, S-2

181. An individual with a pulse rate of 110 beats per minute at rest might be diagnosed with a condition generally known as:
(A) Bradycardia
(B) Tachycardia

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(C) Hypertension
(D) Hypotension

182. During double circulation in a human being, blood passes through the heart:
(A) Once to complete one cycle
(B) Twice to complete one cycle
(C) Thrice to complete one cycle
(D) Four times to complete one cycle

183. Which blood group is known as the universal donor because it lacks A and B antigens on the red blood cells?
(A) A
(B) B
(C) AB
(D) O

184. In tall trees like eucalyptus, which is the primary mechanism for water transport to the topmost leaves?
(A) Transpiration pull
(B) Active transport
(C) Root pressure
(D) Osmotic pressure in phloem

185. When blood is collected in a test tube and allowed to clot, the clear yellowish fluid that separates out is called:
(A) Lymph
(B) Serum
(C) Cytoplasm
(D) Fibrin

186. Which valve is located between the left atrium and the left ventricle?
(A) Tricuspid valve
(B) Bicuspid (mitral) valve
(C) Aortic semilunar valve
(D) Pulmonary semilunar valve

187. Water absorbed by root hairs moves deeper into the root layers eventually reaching the xylem. This movement cell-to-cell is primarily due to:
(A) Transpiration
(B) Diffusion
(C) Osmosis
(D) Evaporation

188. Which component of the blood forms a plug at the site of a ruptured blood vessel to reduce blood loss?
(A) Erythrocytes
(B) Leukocytes
(C) Platelets
(D) Lymphocytes

189. Hypertension is clinically defined as blood pressure persistently higher than:
(A) 120/80 mm Hg
(B) 90/60 mm Hg
(C) 140/90 mm Hg
(D) 100/70 mm Hg

190. Consider the following statements about osmosis and diffusion:
I. Osmosis involves the movement of water across a semi-permeable membrane.
II. Diffusion can occur in any medium (solid, liquid, gas).
III. Osmosis requires expenditure of ATP energy by the cell.
Which of the given statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

191. Lymph nodes play a crucial role in the body by:
(A) Actively pumping central lymph fluid throughout the human body system
(B) Filtering bacteria and foreign matter from lymph
(C) Transporting dissolved metabolic carbon dioxide gas directly to the lungs
(D) Continually producing new erythrocyte red blood cells in large volumes

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192. Which phenomenon explains why a plant wilts when water lost through transpiration exceeds water absorbed by the roots?
(A) Increase in root pressure
(B) Excessive active transport in phloem
(C) Clotting of sap in xylem
(D) Loss of turgor pressure in cells

193. The normal lifespan of a human red blood cell is approximately:
(A) 10 days
(B) 30 days
(C) 120 days
(D) 365 days

194. If the tricuspid valve in the heart is damaged, blood will flow back into the:
(A) Left atrium
(B) Left ventricle
(C) Right atrium
(D) Pulmonary artery

195. Consider the following statements regarding heart attack and hypertension:
I. Hypertension is high blood pressure inside the arteries.
II. A heart attack is caused by a blocked coronary artery.
III. Hypertension can lead to the rupture of blood vessels.
IV. A heart attack means the heart has completely stopped beating (cardiac arrest).
Which of the given statements are correct?
(A) I, II, and III only
(B) II, III, and IV only
(C) I, III, and IV only
(D) I, II, III, and IV

196. The major function of white blood cells (WBCs) is to:
(A) Transport oxygen gas to tissues
(B) Initiate the blood clotting process
(C) Provide immunity
(D) Transport dissolved organic food nutrients

197. Which of the following is true for the transport of food in plants?
(A) It requires ATP
(B) It occurs through dead xylem cells
(C) It is always strictly upwards
(D) It does not depend on osmotic pressure

198. The cohesion-tension theory explains the ascent of sap in plants. "Cohesion" refers to the attraction between:
(A) Water molecules and xylem walls
(B) Water molecules and each other
(C) Sugar molecules and phloem walls
(D) Water molecules and sugar molecules

199. What distinguishes blood plasma from the total blood volume?
(A) Plasma strictly includes only suspended red and white cellular elements
(B) Yellowish fluid left when blood cells are removed
(C) Plasma functions as the primary oxygenated cellular portion of blood
(D) Plasma contains only essential coagulation proteins and clotting factors

200. The source-sink mechanism describes the flow of materials in the phloem. In the spring season, when a plant starts growing new buds, the "source" of food is primarily the:
(A) Developing newly forming leaf blades
(B) Root storage tissues
(C) Non-living xylem vessel elements
(D) Reproductive flower buds

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ANSWERS

1. (D) All cells are not in direct contact with the surrounding environment
Simple diffusion relies on passive movement across surface boundaries, which is effective only over microscopic distances. In large multicellular organisms such as humans, most body cells are situated far from the external surface and lack direct environmental contact. Consequently, diffusion alone cannot transport oxygen rapidly or deeply enough to satisfy metabolic demands.

2. (C) Blood
Blood is a specialized fluid connective tissue consisting of cellular elements suspended in a liquid plasma matrix. It circulates continuously through the vascular system, acting as the primary medium for distributing oxygen from the lungs, nutrients absorbed from digestion, and metabolic waste products like carbon dioxide throughout the body to maintain homeostasis.

3. (B) Transport of water and minerals
Xylem tissue serves as a specialized vascular pipeline in higher vascular plants, primarily responsible for conducting water and essential dissolved inorganic minerals absorbed from the soil by root hairs. This unidirectional upward movement delivers water and essential nutrients throughout the stem to photosynthetic leaves, supporting cellular metabolism, structural turgidity, and plant growth.

4. (D) Sucrose
Photosynthesis in green leaf cells generates simple carbohydrates, which are readily converted into sucrose for transport. Sucrose is a soluble disaccharide that remains chemically stable during active translocation. It moves through living phloem sieve tube elements from photosynthetic source organs to growing metabolic sinks, such as developing roots and fruits, providing vital cellular energy.

5. (C) Four
The human heart contains four distinct internal chambers comprising two upper receiving atria and two lower pumping ventricles. A thick central muscular septum physically separates the left and right halves. This structural division prevents oxygenated blood returning from the lungs from mixing with deoxygenated blood returning from bodily tissues, optimizing systemic oxygen delivery.

6. (C) Red blood cells
Mature red blood cells lose their nucleus during cellular differentiation, creating additional cytoplasmic volume to store high quantities of haemoglobin. Haemoglobin is an iron-containing respiratory protein that reversibly binds oxygen molecules in the pulmonary capillaries. This structural adaptation allows mature erythrocytes to efficiently transport bound oxygen from the lungs to systemic body tissues.

7. (A) Osmosis
Osmosis represents a specific form of passive diffusion restricted to solvent molecules, primarily water. It occurs across a selectively permeable membrane from an area of higher water concentration to an area of lower water concentration. This physical mechanism operates spontaneously down a water potential gradient without requiring chemical energy expenditure by living biological cells.

8. (D) Arteries
Arteries are heavy vascular channels designed to transport blood away from heart ventricles toward peripheral body tissues and organs. Because blood exits the heart under elevated hydrostatic pressure generated by ventricular contractions, arterial vessel walls possess thick layers of smooth muscle and elastic fibers, accommodating high pressure waves while preserving continuous blood movement.

9. (B) They have thick, highly elastic walls
Veins are blood vessels responsible for returning blood from tissue capillary beds back toward the heart. Since blood inside veins flows under reduced hydrostatic pressure, their muscular and elastic wall layers are noticeably thinner compared to arterial walls. Veins feature internal flap valves that maintain unidirectional venous blood flow toward the central cardiac chambers.

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10. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
The left ventricle pumps oxygenated blood throughout the expansive systemic arterial circuit to distant tissues, requiring substantial mechanical force to overcome vascular resistance. Consequently, its myocardial wall is considerably thicker and more muscular than that of the right ventricle, which only propels deoxygenated blood over a short distance to nearby lungs under low pressure.

11. (D) Leukocytes
Leukocytes, commonly known as white blood cells, form the primary cellular defense mechanism of the immune system. They protect the body by engulfing foreign pathogens through phagocytosis, neutralizing toxic substances, and producing specialized antibodies. Their main biological function is identifying, targeting, and eliminating infectious microbes to maintain internal health and cellular integrity.

12. (A) Transpiration
Transpiration is the physiological process involving the continuous loss of excess water in the form of water vapor from the aerial surfaces of plants, mainly through microscopic stomatal pores on leaves. This surface evaporation generates a continuous tension gradient inside xylem vessels, facilitating mineral uptake, cooling delicate leaf tissues, and promoting plant transport.

13. (B) Platelets
Platelets, also known as thrombocytes, are specialized cell fragments in circulating blood essential for hemostasis. When a vascular injury occurs, platelets adhere to damaged blood vessel surfaces and release coagulation factors. These enzymatic signals trigger a cascade converting plasma proteins into insoluble fibrin threads, creating a protective clot to seal vascular tears.

14. (B) Tricuspid valve
The tricuspid valve consists of three muscular cusps situated between the right atrium and right ventricle of the human heart. When the right ventricle contracts during systole, elevated fluid pressure pushes these flexible leaflets together to seal the orifice, preventing backward flow of deoxygenated blood into the receiving right atrium.

15. (A) Root hair → Cortex → Endodermis → Xylem
Soil water enters the plant body by osmosis across delicate root hair cell membranes. Water then moves radially inward through adjacent parenchyma cells of the root cortex toward the inner tissue layers. After crossing the selective endodermal barrier containing the Casparian strip, water enters the central dead vascular elements of root xylem.

16. (C) Pulmonary vein
Pulmonary veins carry oxygenated blood from alveolar capillaries within the lungs back to the human heart. Unlike standard veins that carry deoxygenated blood, these specialized vessels transport freshly oxygenated blood into the left atrium. From the left atrium, blood passes into the left ventricle for distribution through systemic arterial pathways.

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17. (D) Systemic and pulmonary
Double circulation in birds and mammals comprises two distinct closed vascular circuits connected through the heart. Pulmonary circulation directs deoxygenated blood from the right ventricle to the lungs for gas exchange and returns oxygenated blood to the left atrium. Systemic circulation distributes oxygen-rich blood from the left ventricle to systemic tissues and organs.

18. (C) 120/80 mm Hg
Standard arterial blood pressure in a healthy resting adult human is recorded around 120/80 millimeters of mercury. The numerator represents systolic pressure, measuring maximum arterial tension during active left ventricular contraction. The denominator represents diastolic pressure, measuring minimum resting arterial pressure while heart chambers relax and fill with blood between cardiac contractions.

19. (B) Sphygmomanometer
A sphygmomanometer is a specialized medical diagnostic instrument used to quantify arterial blood pressure. It consists of an inflatable rubber cuff connected to a measuring gauge that records fluid pressure in millimeters of mercury. By temporarily occluding the brachial artery, medical professionals measure maximum systolic and minimum diastolic pressure values accurately.

20. (A) P-3, Q-4, R-2, S-1
The aorta is the largest systemic artery carrying oxygenated blood from the heart. The vena cava is the primary vein returning deoxygenated blood from body tissues. The pulmonary artery transports deoxygenated blood directly to the lungs for gas exchange. Microscopic blood capillaries form narrow vascular networks that facilitate nutrient and gas exchanges.

21. (D) Red blood cells
Lymph is a clear fluid formed when interstitial fluid enters lymphatic capillaries. Because red blood cells are too large to escape through capillary wall junctions into tissue spaces, lymph completely lacks red blood cells and haemoglobin. Consequently, lymph appears colorless while retaining water, dissolved nutrients, small plasma proteins, and white blood cells.

22. (A) Transpiration pull
During daytime hours, solar radiation induces evaporation of water through open stomatal pores on leaves. This water loss creates negative pressure or tension within the leaf mesophyll. Because water molecules exhibit strong cohesive forces, this tension generates a continuous upward pull that draws water through xylem vessels from roots to tree canopy tops.

23. (C) Plasma
Plasma constitutes the non-cellular liquid matrix of blood, accounting for over half of total blood volume. Composed primarily of water, plasma holds dissolved protein molecules, glucose, mineral salts, metabolic nitrogenous wastes, and regulatory hormones. It serves as a transport medium suspending cellular blood elements like red cells, white cells, and platelets throughout circulation.

24. (A) Blood group O
Individuals with blood group O lack both A and B agglutinogen antigens on their red blood cell surface membranes. When transfused into individuals of other blood groups, these donor red cells do not trigger immune destruction by host plasma antibodies. Consequently, blood group O individuals serve as universal donors in clinical blood transfusions.

25. (C) Iron
Iron is an essential chemical element present within the central heme ring structure of haemoglobin molecules inside red blood cells. Each iron atom reversibly binds an oxygen molecule in alveolar blood capillaries. Adequate dietary iron intake is necessary to produce functional haemoglobin, ensuring sufficient oxygen transport capacity throughout human body tissues.

26. (B) Anaemia
Anaemia is a clinical condition characterized by a reduced concentration of functional haemoglobin or a decreased total count of circulating red blood cells. This deficiency impairs the oxygen-carrying capacity of blood, leading to tissue hypoxia. Affected individuals frequently experience persistent fatigue, muscular weakness, paleness of skin, and general physical lethargy.

27. (D) Active transport
Translocation of soluble photosynthetic products into phloem sieve elements requires living companion cells to pump sucrose molecules against concentration gradients. This movement uses metabolic energy derived from adenosine triphosphate hydrolysis. Accumulation of sucrose inside sieve tubes alters osmotic potential, driving water movement and mass fluid transport throughout the plant body.

28. (A) Stomata
Stomata are microscopic pores located primarily on the epidermal surface of plant leaves, surrounded by paired guard cells. These specialized structures regulate gaseous exchange by allowing carbon dioxide influx for photosynthesis and oxygen release. Simultaneously, stomata mediate transpiration by releasing excess water vapor from internal leaf tissue into the surrounding atmosphere.

29. (C) Systole
Systole refers to the active contraction phase of the cardiac cycle, during which heart chambers exert mechanical force on contained blood. Ventricular systole increases fluid pressure within the ventricles, driving deoxygenated blood through the pulmonary artery to the lungs and oxygenated blood through the main aorta to systemic tissues throughout the body.

30. (A) I and II only
The right atrium receives deoxygenated blood returning from bodily tissues through the vena cava, while the left atrium collects oxygenated blood arriving from the lungs via pulmonary

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veins. Conversely, the right ventricle pumps deoxygenated blood toward the lungs for gas exchange, making the third statement factually incorrect regarding human cardiac circulation.

31. (D) Xylem vessels
Xylem vessels are specialized conducting tubes formed from elongated vertical rows of plant cells that undergo programmed cell death at maturity. During development, their living contents break down and cell walls become heavily lignified. This structural decay creates continuous, hollow, non-living tubular conduits optimized for bulk transport of water and dissolved minerals.

32. (B) Twice
In human circulation, blood completes a single full circuit through the body by passing through the central heart twice. Deoxygenated blood enters the right side of the heart and is pumped to the lungs. Oxygenated blood then returns to the left side of the heart before being distributed to systemic tissues worldwide.

33. (C) Tracheids
Phloem tissue comprises four major cellular components: sieve tube elements, companion cells, phloem parenchyma, and phloem fibers, which function together to translocate organic nutrients. Conversely, tracheids are dead, elongated, lignified cells exclusively belonging to xylem tissue, where they serve as primary conductive elements for transporting water and dissolved inorganic minerals.

34. (B) Transpiration stops completely
Stomatal pores close during nighttime hours when photosynthesis ceases and light is absent. Because stomata serve as the main pathway for water vapor exit from leaf tissues, complete closure prevents transpiration. This nocturnal mechanism conserves plant water reserves while maintaining internal cell turgidity when solar radiation is unavailable to drive transpiration pull.

35. (A) IV, II, III, I
Freshly oxygenated blood leaving alveolar capillaries in the lungs flows through the pulmonary veins directly into the left atrium of the heart. Upon atrium contraction, blood moves through the bicuspid valve into the left ventricle. Finally, strong contraction of the left ventricle propels oxygenated blood into the aorta for systemic distribution.

36. (A) Capillaries
Capillaries are microscopic, thin-walled blood vessels connecting terminal arterioles to microscopic venules. Composed of a single endothelial cell layer, these extensive vascular networks permeate body tissues. Their ultra-thin structure allows efficient diffusion and exchange of metabolic gases, dissolved nutrients, water, and cellular waste products between circulating blood and surrounding interstitial fluids.

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37. (D) Root pressure
During nighttime hours, stomatal pores remain closed, halting transpiration pull. Active absorption of inorganic mineral ions by root endodermal cells continues to decrease root osmotic potential. Water enters root cells by osmosis, generating positive hydrostatic root pressure. This pushing force drives continuous water movement up xylem vessels when transpiration forces are inactive.

38. (A) Rhesus monkey
The Rh factor is an inherited erythrocyte surface antigen named after the Rhesus monkey, Macaca mulatta, in which it was first identified during medical research. Individuals possessing this specific protein antigen on their red blood cell membranes are classified as Rh-positive, whereas those lacking the antigen are designated as Rh-negative in blood typing.

39. (C) Transporting oxygen to brain cells
The lymphatic system collects excess interstitial tissue fluid, absorbs digested lipids via intestinal lacteals, and defends against microbial pathogens using specialized lymphocytes within lymph nodes. Oxygen transport to brain tissues and other vital organs is performed exclusively by haemoglobin within red blood cells inside the systemic blood circulatory network, not by lymph.

40. (A) I, II, and III only
Normal human resting arterial blood pressure measures approximately 120 mm Hg during ventricular contraction and 80 mm Hg during ventricular relaxation. Chronic elevation of arterial pressure is defined as hypertension. Blood pressure measurements are routinely taken from major systemic muscular arteries rather

than veins, making the fourth listed statement factually incorrect.

41. (A) Heart attack
A heart attack, or myocardial infarction, occurs when a coronary artery becomes obstructed by an atherosclerotic plaque or blood clot. This vascular blockage cuts off vital oxygenated blood supply to a segment of the heart muscle. Without adequate oxygen, affected myocardial cells undergo rapid ischemia, structural damage, and irreversible tissue death.

42. (B) Osmosis
Root hair cells actively accumulate dissolved mineral ions from surrounding soil water, creating a higher solute concentration inside their cytoplasm relative to the soil solution. This osmotic potential difference drives water molecules across the selectively permeable root hair membranes into the root cortex through passive osmosis, initiating fluid uptake into the plant body.

43. (B) Water molecules cohere and are pulled upward by transpiration
The cohesion-tension theory explains how sap ascends tall trees. Hydrogen bonding between polar water molecules creates strong cohesive forces, maintaining unbreakable water columns in narrow xylem vessels. Evaporation of water from leaf stomata generates negative tension, pulling the cohesive water column continuously upward from roots to leaves without collapse.

44. (B) They initiate the blood clotting process
When a blood vessel is injured, circulating platelets immediately adhere to exposed collagen fibers at the damaged tissue site. Activated platelets change shape, aggregate into a mechanical plug, and release clotting enzymes like thromboplastin. These chemical signals trigger a coagulation cascade, forming an insoluble fibrin matrix that seals vascular ruptures.

45. (C) Fibrinogen
During the ultimate step of the coagulation cascade, the active enzyme thrombin converts soluble blood plasma protein fibrinogen into insoluble fibrin monomers. These fibrin strands rapidly polymerize into a sticky, mesh-like fibrous net. This network traps circulating red blood cells and platelets, stabilizing the initial plug into a durable blood clot.

46. (B) Lungs
Deoxygenated blood carrying dissolved carbon dioxide waste is pumped from the right ventricle through the pulmonary artery into alveolar capillaries within the lungs. Carbon dioxide diffuses out of blood into pulmonary alveoli to be exhaled, while incoming oxygen binds to haemoglobin. The oxygenated blood then returns to the heart via pulmonary veins.

47. (D) AB
Individuals with blood group AB possess both A and B antigens on their red blood cell surface membranes. Because their immune systems recognize both antigens as self-proteins, their blood plasma lacks anti-A and anti-B antibodies. Consequently, individuals with blood group AB can safely receive red blood cell transfusions from all ABO blood types.

48. (B) 70-80 beats per minute
A healthy adult human resting heart rate typically ranges between 70 and 80 beats per minute, averaging approximately 72 beats per minute. Each cardiac cycle comprises coordinated contraction and relaxation phases driven by electrical impulses from the sinoatrial node, ensuring steady circulation of oxygenated blood throughout systemic bodily organs at rest.

49. (B) To pump blood to various organs at high pressure
Atria serve as receiving chambers that push blood a short distance into adjacent lower ventricles under minimal force. Conversely, ventricles act as primary cardiac pumps that must generate substantial fluid pressure. Ventricular walls contain thick layers of cardiac muscle to propel blood into systemic and pulmonary arteries against high vascular resistance.

50. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Transpiration causes significant loss of water from plant leaves, which can lead to wilting under drought conditions. However, it is essential because the evaporation generates transpiration pull for mineral transport and provides evaporative cooling to safeguard plant cells from thermal damage. Therefore, transpiration is considered a necessary evil for plant survival.

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51. (D) Sucrose
Phloem translocation of organic nutrients involves actively loading sucrose from photosynthetic mesophyll cells into companion cells and sieve tube elements. This process utilizes cellular energy in the form of ATP to transport sugar molecules against concentration gradients. The resulting osmotic changes drive mass flow of phloem sap throughout various plant tissues.

52. (A) Water moves from xylem into phloem by osmosis
Active loading of sucrose into phloem sieve tube elements significantly increases solute concentration within the phloem sap, lowering its water potential. In response to this osmotic gradient, water moves passively from adjacent xylem vessels into phloem sieve tubes by osmosis. This water influx generates high hydrostatic pressure, driving fluid translocation.

53. (B) Kidneys
The renal system and circulatory system interact directly in the kidneys, where metabolic wastes are removed from circulating blood. Renal arteries deliver oxygenated blood containing urea and nitrogenous metabolic products to nephron glomeruli. Here, filtration removes toxic urea while retaining essential blood cells and proteins, maintaining metabolic balance and fluid homeostasis.

54. (C) Plasma - Transport of nutrients and hormones
Blood plasma is the liquid fluid matrix responsible for transporting dissolved nutrients like glucose, amino acids, metabolic wastes, and regulatory hormones to target body tissues. Conversely, red blood cells carry oxygen gas, white blood cells provide pathogen defense, and cellular platelets initiate coagulation, making the plasma option the only correct functional pairing.

55. (A) Right atrium → Right ventricle → Pulmonary artery → Lungs
Deoxygenated blood returning from systemic body tissues enters the right atrium of the heart via the vena cava. Upon atrium contraction, blood passes through the tricuspid valve into the right ventricle. Ventricular contraction then propels this deoxygenated blood through the pulmonary semilunar valve and pulmonary artery into the lungs for re-oxygenation.

56. (C) Heartbeats per minute
Pulse rate reflects the expansion and recoil of elastic arterial walls caused by blood ejected during left ventricular contraction. Each heartbeat pushes a wave of high-pressure blood through systemic arteries, which can be felt at superficial pulse points. Consequently, measuring the pulse rate directly indicates the total number of heartbeats per minute.

57. (B) Hypertension
Hypertension is the medical term for chronically elevated arterial blood pressure exceeding normal physiological parameters. It occurs when small systemic arteries constrict or lose elasticity, increasing resistance against blood flow from the heart. Unmanaged hypertension places strain on heart muscles and can damage sensitive organ capillaries in kidneys and brain.

58. (D) Growing fruits and roots
In plant transport, a "sink" is any non-photosynthetic organ or actively growing tissue that consumes or stores translocated organic nutrients. During summer, photosynthesizing leaves produce excess carbohydrates that are translocated through phloem sieve tubes toward sink organs, such as developing fruits, growing roots, and storage tubers, to support cell division and growth.

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59. (C) Valves present in the heart
Unidirectional blood flow through the heart is maintained by specialized flap-like valves. Atrioventricular valves prevent backflow into the atria during ventricular contraction, while semilunar valves prevent blood from returning to the ventricles from arterial trunks during relaxation. These anatomical structures close automatically under hydrostatic pressure changes, ensuring efficient unidirectional circulation.

60. (A) P-2, Q-3, R-1, S-4
Transpiration is the evaporative loss of water vapor from leaf surfaces. Translocation refers to the active movement of dissolved organic nutrients through phloem tissue. Osmosis involves water movement across a selectively permeable membrane down concentration gradients. Diffusion describes passive movement of gaseous or dissolved particles from high to low concentration regions.

61. (C) Occurs in any medium without a membrane
Diffusion is the passive movement of solute particles or gas molecules down concentration gradients, occurring in gas, liquid, or solid media without needing a biological membrane. In contrast, osmosis is restricted to solvent water movement across a selectively permeable membrane, distinguishing it from simple non-membrane diffusion processes in biological and physical systems.

62. (D) Pumping organ
The human heart functions as a muscular pumping organ that maintains continuous blood circulation throughout the body. Through rhythmic cycles of contraction and relaxation, it generates hydrostatic pressure necessary to propel oxygenated blood to systemic tissues and pump deoxygenated blood to the lungs for gas exchange, supporting respiratory and metabolic functions.

63. (A) Plasma
Plasma is the extracellular liquid matrix of blood, comprising roughly 55 percent of total blood volume. It is composed of approximately 90 percent water and 10 percent dissolved solutes, including vital plasma proteins, mineral salts, nutrients, metabolic wastes, and hormones, providing a liquid transport medium for circulating blood cells.

64. (D) It keeps oxygenated and deoxygenated blood separate
The septum is a thick muscular wall physically dividing the left and right sides of the heart. By separating cardiac chambers, it prevents oxygenated blood returning from the lungs into the left atrium and ventricle from mixing with deoxygenated blood in the right chambers, preserving high systemic oxygenation efficiency in warm-blooded vertebrates.

65. (B) Unidirectionally from roots to leaves
Xylem vessels transport water and dissolved mineral nutrients in a strictly unidirectional upward path, moving from soil-absorbing root hairs through the stem to photosynthetic leaves. This direction is driven by physical root pressure and evaporative transpiration pull, ensuring a continuous water supply to aerial plant tissues without reverse fluid movement.

66. (D) Veins possess valves that prevent backflow
Veins transport blood back toward the heart under lower hydrostatic pressure than arterial blood. To compensate for reduced pressure and overcome gravitational pull, veins feature internal one-way flap valves. These valves open toward the heart and close tightly against reverse flow, ensuring steady unidirectional venous return from lower body tissues.

67. (A) Septum
The septum is a vertical muscular partition dividing the right and left heart chambers. It comprises an interatrial portion between the upper receiving chambers and an interventricular portion between the lower pumping chambers. This structural barrier ensures complete physical separation of oxygen-rich blood on the left side from oxygen-poor blood on the right.

68. (D) Blood circulation between the heart and body tissues
Systemic circulation is the pathway of closed vascular flow that transports oxygenated blood from the left ventricle through the main aorta to capillary beds in peripheral body tissues. After delivering oxygen and nutrient molecules, it collects metabolic carbon dioxide waste, returning deoxygenated blood via the vena cava to the right atrium.

69. (C) Iron
Dietary iron is a critical micro-mineral required for synthesizing functional haemoglobin molecules inside red blood cell precursors. Insufficient iron intake impairs haemoglobin production, reducing red blood cell concentration and triggering iron-deficiency anaemia. Consuming iron-rich foods like green leafy vegetables and legumes helps maintain healthy red blood cell production.

70. (A) I and II only
Lymph contains lower protein concentrations than blood plasma because large serum proteins cannot easily pass through blood capillary walls into tissue spaces. Lymph flows unidirectionally from body tissues back toward venous blood. Red blood cells are produced inside bone marrow rather than lymph nodes, making the third listed statement incorrect.

71. (D) Systolic pressure
Systolic pressure measures the maximum force exerted by circulating blood against arterial

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walls when the left ventricle contracts during cardiac systole. In a healthy adult at rest, normal systolic pressure averages around 120 millimeters of mercury. This value forms the upper number recorded during routine clinical blood pressure measurements.

72. (A) O
Individuals with blood group O lack both A and B antigens on their red blood cell surface membranes. Because these antigens were not present during immune system development, their blood plasma produces both anti-A and anti-B antibodies. These circulating antibodies attack transfused red blood cells carrying foreign A or B surface antigens.

73. (B) Transport is bidirectional based on plant needs
Unlike xylem transport, which moves water exclusively upward from roots to leaves, phloem transport of organic sugars is bidirectional. Sucrose can move upward or downward through living sieve tube elements depending on seasonal requirements and the locations of photosynthetic sources relative to non-photosynthetic metabolic sink organs, such as roots and fruits.

74. (D) It helps re-establish continuous water columns in the xylem
Active uptake of mineral ions by root cells creates positive hydrostatic root pressure, pushing water upward into lower xylem conduits. While transpiration pull acts as the main driver in tall trees, root pressure maintains hydraulic continuity by refilling cavitated xylem vessels and re-establishing unbroken water columns during night hours when transpiration stops.

75. (C) Red blood cells
Erythrocytes is the medical term for red blood cells, which are the most abundant cellular elements in human blood. These specialized biconcave cells lack nuclei at functional maturity and contain haemoglobin. Their primary function is binding oxygen in pulmonary capillaries and distributing it to metabolic tissues throughout the body system.

76. (B) Supply more oxygen and glucose to the muscles
During intense physical exercise, skeletal muscle cells increase cellular respiration to generate adenosine triphosphate for mechanical contraction. The heart rate accelerates to boost cardiac output, accelerating blood flow through muscular capillaries. This delivers additional dissolved oxygen gas and glucose molecules to exercising muscles while rapidly removing metabolic waste products.

77. (D) Kidneys
The kidneys serve as primary filtration organs for removing metabolic nitrogenous wastes, such as urea and uric acid, from circulating blood. Renal arteries direct blood into microscopic nephrons, where high hydrostatic pressure filters metabolic wastes and excess water into renal tubules while retaining blood cells, forming urine for eventual excretion.

78. (A) It increases
Transpiration rates increase under hot, sunny, and windy conditions. High temperatures provide thermal energy for water evaporation from mesophyll cell walls, while sunlight stimulates stomatal opening. Concurrent wind removes accumulated water vapor around leaves, maintaining a steep concentration gradient that drives rapid diffusion of moisture into dry surrounding air.

79. (C) Pulmonary artery
Arteries are vascular channels defined by carrying blood away from heart ventricles. While systemic arteries transport oxygenated blood to peripheral organs, the pulmonary artery is a notable exception. Originating from the right ventricle, it carries deoxygenated blood returning from bodily tissues directly to the lungs for gas exchange and re-oxygenation.

80. (A) I, II, and IV only
Transpiration generates negative pressure tension that pulls xylem water upward and cools leaf tissues via evaporative heat loss. It occurs primarily through stomatal pores. Sugar transport is performed by phloem translocation rather than transpiration, making the third statement incorrect regarding plant water relations and vascular physiology.

81. (D) Bicuspid valve
The bicuspid valve, also known as the mitral valve, is an atrioventricular valve located between the left atrium and left ventricle. Composed of two fibrous cusps, it opens to allow oxygenated blood flow into the left ventricle and snaps shut

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during ventricular systole, preventing backward leakage of blood into the atrium.

82. (A) Photosynthetic leaves
In plant physiology, a "source" is any organ or tissue capable of producing or exporting organic nutrients in excess of its own metabolic needs. Fully expanded mature leaves act as primary source organs during warm weather because active photosynthesis generates abundant sucrose, which is loaded into phloem sieve tubes for transport.

83. (B) Consist of a single layer of cells
Capillaries feature ultra-thin walls consisting of a single layer of squamous endothelial cells resting on a delicate basement membrane. This simple structural organization distinguishes capillaries from larger muscular arteries and veins, facilitating rapid diffusion of respiratory gases, dissolved nutrients, and metabolic waste products between circulating blood and surrounding body tissues.

84. (D) Fatigue and weakness
Severe anaemia reduces circulating haemoglobin and red blood cells, impairing oxygen delivery to systemic body tissues. Lacking sufficient oxygen, cellular respiration slows, reducing adenosine triphosphate production in skeletal muscle and brain tissues. Consequently, individuals with severe anaemia experience characteristic symptoms of persistent physical fatigue, systemic weakness, and exertional shortness of breath.

85. (A) III, I, II, IV
Water transport begins when root hairs absorb moisture from soil via osmosis. Stomatal evaporation during transpiration then releases water vapor from leaves, creating negative hydrostatic pressure tension in xylem conduits. This continuous suction force pulls unbroken water columns upward through stem xylem vessels toward photosynthetic leaf tissues.

86. (C) Pericardium
The pericardium is a protective fibroserous sac enclosing the human heart. Composed of an outer fibrous layer and an inner double-layered serous membrane, it contains pericardial fluid within its cavity. This fluid lubricates cardiac surfaces during continuous muscle contractions, minimizing mechanical friction and protecting the beating heart against external trauma.

87. (A) Has the Rh antigen on their red blood cells
An individual classified as Rh-positive possesses the specific Rh surface protein antigen, known as antigen D, on their circulating red blood cells. Inheritance of this surface protein determines Rh blood group compatibility, requiring careful blood cross-matching during clinical blood transfusions to prevent harmful immune reactions in Rh-negative recipients.

88. (D) Translocation
Translocation is the physiological process of transporting soluble photosynthetic products, primarily sucrose, from green leaves to non-photosynthetic plant organs. Occurring within living phloem sieve tube networks, translocation moves organic sugars upward or downward using active metabolic energy, supporting growth, energy metabolism, and carbohydrate storage throughout the plant body.

89. (C) Cohesion
Cohesion is the intermolecular attraction between like polar molecules, resulting from extensive hydrogen bonding among water molecules. Inside narrow xylem vessels, high cohesive force holds water molecules tightly together, forming an unbroken continuous water column capable of withstanding immense tension created by evaporative transpiration pull without breaking or cavitating.

90. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Veins possess thinner, less muscular walls than arteries because blood returning from systemic capillary beds flows under significantly reduced pressure. Because veins do not experience high-pressure cardiac output surges, their structural walls do not require thick muscular or elastic layers to maintain structural integrity, making the reasoning statement factually accurate.

91. (B) Wrist or neck
Pulse rate is routinely evaluated by compressing a superficial muscular artery against underlying bone structure using fingertips. Commonly chosen anatomical sites include the radial artery at the anterior wrist and the carotid artery along the anterolateral neck, where strong arterial pressure waves generated by left ventricular contractions can be easily palpated.

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92. (B) Vena Cava - Carries oxygenated blood
The vena cava comprises large systemic veins that collect deoxygenated blood from upper and lower body tissues, returning it to the right atrium of the heart. Describing the vena cava as carrying oxygenated blood is factually incorrect, as oxygenated blood is carried by the aorta and pulmonary veins within human circulation.

93. (B) Draining excess fluid back to blood
During capillary fluid exchange, hydrostatic pressure forces liquid out of blood plasma into surrounding tissue spaces. The primary function of the lymphatic system is collecting this excess interstitial fluid through specialized lymphatic capillaries. Lymphatic vessels filter the fluid through lymph nodes and return it to venous circulation, maintaining overall fluid balance.

94. (D) Hypertension
A resting blood pressure reading of 145/95 millimeters of mercury exceeds standard physiological healthy limits of 120/80 mm Hg. The elevated systolic value of 145 mm Hg and diastolic value of 95 mm Hg indicate abnormally high arterial vascular resistance, leading to a medical diagnosis of stage-one hypertension requiring clinical monitoring.

95. (B) Osmotic pressure
According to the pressure-flow hypothesis, active loading of sucrose into phloem sieve elements increases solute concentration, causing water to enter from adjacent xylem by osmosis. This water influx generates high hydrostatic osmotic pressure at the source. Sap moves along this pressure gradient toward sink tissues, where sucrose unloading lowers hydrostatic pressure.

96. (C) Plasma
Carbon dioxide produced during cellular respiration is transported in blood primarily as dissolved bicarbonate ions within liquid plasma. Plasma water acts as a fluid solvent carrying dissolved gases and metabolic wastes from systemic tissue capillaries to alveolar capillaries in the lungs, where carbon dioxide diffuses into air spaces for exhalation.

97. (A) Fibrinogen
During blood coagulation, activated thrombin acts as a proteolytic enzyme that cleaves soluble plasma protein fibrinogen molecules. This reaction converts fibrinogen into insoluble fibrin monomers, which spontaneously polymerize into long structural strands. These strands interlace to form a stable fibrous mesh that seals injured blood vessels and stops bleeding.

98. (B) Unidirectional
Water and dissolved mineral ions move through xylem conduits in a strictly unidirectional path. Driven by root pressure and transpiration pull, xylem sap moves exclusively upward from soil-absorbing root tissues through stem xylem into photosynthetic leaf mesophyll, where water evaporates through stomatal pores into the surrounding atmosphere.

99. (D) High humidity
High atmospheric humidity decreases the rate of transpiration by reducing the moisture concentration gradient between internal leaf air spaces and surrounding ambient air. When surrounding air contains elevated water vapor levels, water evaporation through stomatal pores slows down, whereas high temperature, wind speed, and light intensity increase transpiration rates.

100. (A) P-3, Q-1, R-2, S-4
Blood group A red cells express surface antigen A. Group O red cells lack surface antigens, making group O individuals universal red cell donors. The Rh factor represents a blood protein antigen first identified in Rhesus monkeys. Haemoglobin is an iron-bearing protein pigment inside red cells that binds and transports respiratory oxygen.

101. (C) Heart
The human heart is the central muscular pumping organ of the circulatory system. Divided into four muscular chambers, it rhythmically contracts to pump blood through systemic and pulmonary vascular loops. Cardiac contractions generate the hydrostatic force needed to distribute oxygen, nutrients, and hormones to tissues while returning waste products to excretory organs.

102. (A) Upper arm
When measuring blood pressure with a sphygmomanometer, the inflatable cuff is positioned around the upper arm level with the heart. Inflating the cuff compresses the brachial artery, allowing clinical estimation of arterial pressure waves as the cuff slowly deflates, yielding accurate measurements of systolic and diastolic blood pressure values.

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103. (C) Xylem and phloem
Xylem and phloem together constitute the vascular tissue system in higher plants. Xylem comprises specialized conduits that transport water and absorbed mineral salts unidirectionally from roots to leaves. Phloem consists of sieve elements and companion cells that translocate organic photosynthetic sugars bidirectionally between plant source leaves and non-photosynthetic metabolic sink organs.

104. (D) Red blood cells
Mature human red blood cells undergo enucleation during development in bone marrow, ejecting their cellular nuclei and organelles. This loss maximizes internal cytoplasmic space for packing high concentrations of haemoglobin molecules. Consequently, red blood cells optimize their oxygen-carrying capacity to efficiently deliver dissolved respiratory gases to body tissues.

105. (B) Heart → Arteries → Capillaries → Veins → Heart
Systemic blood circulation follows a closed vascular circuit originating from the heart. Contraction of the left ventricle propels oxygenated blood into high-pressure arteries, which branch into microscopic tissue capillaries where gas and nutrient exchange occurs. Blood then drains into low-pressure veins, returning deoxygenated blood to the right cardiac atrium.

106. (D) To prevent backflow from ventricles into atria
The bicuspid and tricuspid valves are atrioventricular valves positioned between the corresponding atrial and ventricular chambers of the heart. When ventricles contract during systole, rising fluid pressure forces these flexible valve leaflets shut. This mechanical closure prevents backward flow of blood into the receiving atria, maintaining unidirectional forward blood movement.

107. (A) Movement of molecules against a gradient using ATP
Active transport is an energy-dependent cellular transport process that moves solute ions or molecules across biological cell membranes against established concentration gradients. Membrane transport proteins utilize chemical energy derived from adenosine triphosphate hydrolysis to accumulate required nutrients or mineral ions within living plant cells against electrochemical gradients.

108. (D) Aorta
The aorta is the main arterial trunk originating directly from the left ventricle of the human heart. Featuring thick elastic walls, it receives oxygen-rich blood ejected under high pressure during ventricular systole. The aorta branches into major systemic arteries, distributing oxygenated blood throughout systemic organs and tissues across the body.

109. (C) Their walls are one cell thick
Capillaries possess thin walls consisting of a single layer of flattened endothelial cells. This structure minimizes diffusion distance between blood plasma and surrounding tissue cells. Consequently, water, dissolved metabolic nutrients, respiratory gases, and chemical waste products readily exchange across capillary walls via simple diffusion down concentration gradients.

110. (A) I and II only
Individuals with blood group AB express both A and B surface antigens on red blood cells, while group O individuals lack both antigens. Blood group O is designated as the universal donor rather than the universal recipient, making the third listed statement incorrect regarding human ABO blood group compatibility principles.

111. (D) Lacteals
Lacteals are specialized lymphatic capillaries located within the central core of intestinal villi in the small intestine. During digestion, dietary lipids are emulsified and absorbed into enterocytes, forming fatty chylomicrons. These lipid complexes are absorbed into lacteals, turning lymph into milky chyle before draining into systemic venous circulation.

112. (A) Pulmonary and Systemic
Double circulation in human physiology consists of two separate closed circulatory loops: pulmonary and systemic. Pulmonary circulation pumps deoxygenated blood from the right ventricle to the lungs for gas exchange. Systemic circulation delivers oxygenated blood ejected from the left ventricle to body tissues, returning deoxygenated blood to the right atrium.

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113. (B) Osmosis
Root hairs absorb water from surrounding soil particles primarily through passive osmosis. Active transport of mineral ions into root hair cells establishes a higher intracellular solute concentration than in soil moisture. This concentration difference drives net water movement across selectively permeable root hair membranes into root cells without direct ATP consumption.

114. (B) Septum
The cardiac septum is a solid muscular wall dividing the internal chambers of the human heart into left and right sides. By physically separating these halves, the septum prevents deoxygenated systemic venous blood in the right atrium and ventricle from mixing with oxygenated pulmonary blood inside the left atrium and ventricle.

115. (A) Transport oxygen
Dietary iron is a necessary chemical constituent of heme groups within functional haemoglobin molecules inside red blood cells. Severe iron deficiency impairs red blood cell formation and haemoglobin synthesis, lowering total haemoglobin concentration. This impairment directly reduces the blood's capacity to bind and transport oxygen gas to systemic tissues.

116. (B) Sieve tubes and companion cells
Phloem tissue in higher vascular plants contains two interdependent living cellular structures for organic nutrient transport: sieve tube elements and companion cells. Sieve tube elements form continuous conducting channels lined with perforated sieve plates, while adjacent nucleated companion cells support sieve element metabolic functions and mediate active sucrose loading.

117. (D) Vital organs like brain and kidneys
Persistent severe hypertension subjects small delicate blood vessels throughout systemic organs to elevated mechanical shear forces. High arterial pressure can rupture fragile arteriolar and capillary networks within sensitive tissues, leading to internal hemorrhage and ischemic organ damage, particularly within vital organs like the brain, kidneys, and heart.

118. (B) It pushes water to modest heights and aids guttation
Root pressure is a positive hydrostatic force generated in root xylem by active mineral ion accumulation and osmotic water influx. While insufficient to elevate sap to the tops of tall trees, root pressure pushes water to modest heights in small herbaceous plants and drives liquid exudation, or guttation, through hydathodes.

119. (B) Left atrium
In human circulation, oxygenated blood returning from alveolar capillaries in the lungs travels through four pulmonary veins into the left atrium of the heart. Upon filling, the left atrium contracts, passing oxygen-rich blood through the open bicuspid valve into the left ventricle for systemic ejection through the aorta.

120. (B) I, III, and IV only
White blood cells, or leukocytes, are nucleated immune cells that protect the body against pathogens and are generally larger than red blood cells. Leukocytes lack oxygen-binding haemoglobin pigments, which are found strictly inside red blood cells, making the second statement incorrect regarding the cellular components of human blood.

121. (D) Serum
Serum is the fluid component of blood plasma remaining after blood clots and clotting factors, such as fibrinogen, are removed. While retaining dissolved electrolytes, antibodies, nutrients, and metabolic waste products, serum lacks active coagulation proteins, making it an ideal blood fraction for clinical diagnostic and immunological testing.

122. (C) Medulla oblongata
Involuntary control of cardiac contraction rate is mediated by autonomic cardiac centers in the medulla oblongata of the brainstem. While intrinsic electrical impulses originate from the sinoatrial pacemaker node, autonomic nerve fibers from the medulla oblongata adjust heart rate and stroke volume in response to changing physiological blood pressure.

123. (B) Red blood cells
Anaemia is diagnosed by assessing total red blood cell counts and circulating haemoglobin levels. A patient with severe anaemia exhibits reduced numbers of red blood cells or decreased

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intracellular haemoglobin content. This deficiency lowers systemic oxygen transport, producing classic clinical manifestations of persistent muscular fatigue, paleness, and physical weakness.

124. (D) It generates a strong upward pull or tension
Transpiration aids water movement in plants through evaporative loss of water vapor from leaf stomata into the surrounding atmosphere. This continuous evaporation generates negative hydrostatic pressure tension within leaf mesophyll spaces, pulling cohesive water columns upward through xylem vessels from roots to photosynthetic leaves via transpiration pull.

125. (A) Translocation
Translocation is the vascular process by which manufactured organic food, primarily sucrose, is transported from photosynthetic leaves to other plant organs through phloem sieve elements. Driven by osmotic pressure gradients created by active sugar loading, translocation delivers carbohydrates to non-photosynthetic tissues like roots, stems, flowers, and developing fruits.

126. (B) Platelets and fibrin
Blood coagulation relies on coordinated actions between cellular platelets and insoluble protein threads of fibrin. Platelets adhere to damaged vascular endothelium to form an initial plug and release clotting enzymes. These enzymes convert plasma fibrinogen into an insoluble fibrin meshwork that traps blood cells, sealing injuries and halting bleeding.

127. (B) 60-100 per minute
In a healthy resting adult human, normal pulse rate typically ranges between 60 and 100 beats per minute. Each arterial pulse wave corresponds to a single cardiac cycle driven by sinoatrial node depolarization, reflecting left ventricular contractions pushing oxygenated blood into systemic arterial circulation during rest.

128. (A) To prevent backflow into ventricles from arteries
Semi-lunar valves are pocket-like arterial valves situated at the bases of the pulmonary artery and aorta. During ventricular relaxation, falling fluid pressure within the ventricles causes these valves to snap shut, preventing ejected blood from flowing backward into the cardiac ventricles and maintaining unidirectional systemic arterial output.

129. (D) Xylem transports water and minerals upwards
Xylem is a specialized vascular tissue composed primarily of dead, lignified conducting cells like vessel elements and tracheids. Driven by passive physical forces such as transpiration pull and root pressure, xylem conducts water and dissolved mineral ions unidirectionally upward from root hairs through the stem to photosynthetic leaves.

130. (C) Assertion (A) is true but Reason (R) is false.
The left atrium receives oxygen-rich blood returning from the lungs via pulmonary veins. The pulmonary artery carries deoxygenated blood away from the right ventricle into the lungs for re-oxygenation. Therefore, claiming that the pulmonary artery transports oxygenated blood to the left atrium is a factually incorrect biological statement.

131. (B) Arteriole constriction increasing resistance
Hypertension is primarily caused by abnormal constriction of small systemic arterioles, which increases peripheral vascular resistance against cardiac blood flow. When smooth muscle layers in arterial walls contract excessively, lumen diameters narrow, requiring the heart to pump against higher hydrostatic pressure to maintain systemic tissue perfusion.

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132. (D) Growing fruits
During active fruiting, developing fruits undergo rapid cell division and expansion, requiring abundant metabolic energy and building materials. Consequently, growing fruits serve as primary sink organs that receive translocated sucrose from photosynthetic leaves via phloem sieve tubes, drawing organic nutrients away from vegetative plant parts during crop development.

133. (B) Lymph system
The lymphatic system contains bean-shaped lymph nodes distributed along lymphatic vessels. Lymph nodes house dense collections of lymphocytes and macrophages that filter fluid passing through the lymphatic network. These immune cells phagocytose bacterial pathogens, foreign particulate matter, and cellular debris, preventing systemic spread of infections.

134. (D) Gas exchange in leaves
Diffusion is essential for plant gaseous exchange occurring through leaf stomata. Carbon dioxide diffuses passively down its concentration gradient from surrounding ambient air into internal leaf mesophyll spaces for photosynthesis. Simultaneously, metabolic oxygen gas produced during light reactions diffuses outward through stomatal openings into the atmosphere.

135. (A) Blood passes through the heart twice per cycle
Human circulation is designated as double circulation because blood completes a full circuit through the body by passing through the cardiac chambers twice. Deoxygenated blood travels through the right side of the heart to the lungs, and oxygenated blood returns through the left side before systemic delivery to body tissues.

136. (B) It traps blood cells to stop bleeding
During blood coagulation, insoluble fibrin strands interlace at damaged vascular sites to form a fibrous net. This structural mesh traps circulating red blood cells, white blood cells, and activated platelets, transforming the initial soft platelet plug into a stable blood clot that seals vascular tears and prevents blood loss.

137. (B) Diastole
Diastole refers to the cardiac relaxation phase during which heart muscle fibers lengthen following contraction. During ventricular diastole, falling intraventricular pressure allows atrioventricular valves to open, permitting blood to fill the cardiac chambers from receiving atria prior to the next systolic contraction phase of the cardiac cycle.

138. (C) Vena cava
The vena cava comprises the superior and inferior venae cavae, which are the main systemic veins returning deoxygenated blood to the heart. Collecting oxygen-depleted blood from body tissues, these large venous vessels drain directly into the right atrium, initiating the pulmonary pathway for cardiac re-oxygenation.

139. (C) Transpiration
In tall trees, transpiration pull is the primary physical force driving bulk upward movement of water through xylem vessels. Evaporation of water vapor from leaf stomata generates negative hydrostatic tension in mesophyll cells, drawing unbroken cohesive water columns upward through stem xylem from root tissues to canopy leaves.

140. (A) P-2, Q-1, R-4, S-3
The right atrium receives deoxygenated blood returning from systemic tissues. The left ventricle pumps oxygenated blood through the aorta to the body. The muscular septum separates cardiac halves, preventing blood mixing. The pulmonary artery conducts deoxygenated blood from the right ventricle into the lungs for re-oxygenation.

141. (C) The blood supply to the heart muscle is blocked
A heart attack, or myocardial infarction, occurs when coronary artery branches supplying the heart muscle become blocked by blood clots or atherosclerotic plaques. Deprived of oxygenated blood flow, affected myocardial tissue suffers ischemia and cellular necrosis, impairing cardiac pumping function and threatening systemic circulatory failure.

142. (A) An Rh-negative donor only
An Rh-negative individual lacks the Rh surface antigen on their red blood cells. Transfusing Rh-positive blood introduces foreign Rh antigens, stimulating anti-Rh antibody production that causes red cell hemolysis. Consequently, Rh-negative individuals must receive transfusions strictly from Rh-negative donors to ensure immunological safety during blood transfusions.

143. (B) Higher water concentration to lower water concentration
Osmosis is the net movement of solvent water molecules across a selectively permeable membrane down a concentration gradient. Water moves from a region of higher water concentration to a region of lower water concentration until dynamic osmotic equilibrium is attained, proceeding passively without requiring chemical energy expenditure by living cells.

144. (A) Pale yellow fluid containing water and solutes
Plasma is the straw-colored extracellular fluid matrix of blood, accounting for approximately 55 percent of total blood volume. Composed of roughly 90 percent water and 10 percent dissolved nutrients, proteins, salts, hormones, and waste products, plasma suspends cellular

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components and mediates transport throughout the closed circulatory system.

145. (D) Root pressure pushes water upward slightly
Continuous active absorption of mineral ions by root cells drives osmotic water uptake into root xylem conduits. Accumulating water generates positive hydrostatic root pressure inside the root tissue. This localized fluid pressure pushes water columns upward through lower stem xylem conduits, aiding sap ascent during periods of low transpiration.

146. (A) Plasma
Blood plasma serves as the principal liquid medium transporting dissolved metabolic substances throughout the human body. Because of its high water content, plasma readily dissolves carbon dioxide as bicarbonate, digested nutrients like glucose and amino acids, and nitrogenous waste products like urea, carrying them to excretory and respiratory organs.

147. (B) Stethoscope
A sphygmomanometer is used alongside a stethoscope to measure arterial blood pressure accurately. While the inflatable cuff measures pressure in millimeters of mercury, the stethoscope placed over the brachial artery allows medical clinicians to listen for Korotkoff sounds, marking exact pressure thresholds for systolic and diastolic blood pressure readings.

148. (D) Nucleus
Mature mammalian red blood cells lack a nucleus, having ejected it during erythrocyte differentiation in bone marrow. This structural adaptation frees internal cytoplasmic space for packing large amounts of haemoglobin, maximizing oxygen-carrying capacity while producing a flexible biconcave shape that easily navigates narrow capillary beds throughout body tissues.

149. (B) Osmotic gradients created by active loading
Phloem food transport is driven by hydrostatic pressure differences described in the pressure-flow hypothesis. Active loading of sucrose into sieve tube elements increases solute concentration, causing water to enter from adjacent xylem by osmosis. This creates high osmotic pressure, pushing phloem sap toward sink organs where sugar unloading lowers hydrostatic pressure.

150. (B) I and III only
Arteries feature thick, elastic muscular walls to withstand high hydrostatic pressure waves generated during ventricular systole. Veins collect deoxygenated blood from tissues and transport it back to the heart. Capillaries lack internal valves, relying instead on single-celled endothelial walls for gas exchange, making statement II factually incorrect.

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151. (D) It pumps blood only to nearby lungs
The right ventricle possesses thinner muscular walls than the left ventricle because it pumps blood through the low-resistance pulmonary circuit to nearby lungs. In contrast, the left ventricle must generate significantly higher hydrostatic pressure to overcome systemic vascular resistance and propel oxygenated blood throughout distant tissues of the entire body.

152. (A) Transpiration
Transpiration is essential for plant fluid dynamics, generating negative pressure tension that pulls water and dissolved minerals upward from roots through xylem conduits. Additionally, evaporative cooling from leaf surfaces prevents thermal damage to metabolic enzymes under direct solar heating, making transpiration vital for temperature regulation and nutrient uptake.

153. (B) The closing of the heart valves
The characteristic "lub-dub" heart sounds are produced by the sequential closure of cardiac valves during each heartbeat. The first sound, "lub," occurs when atrioventricular valves snap shut at the start of ventricular systole. The second sound, "dub," results from semilunar valves closing at the start of ventricular diastole.

154. (D) Platelets
Platelets are cellular fragments in blood essential for normal blood clotting and primary hemostasis. A deficiency in platelet count, known as thrombocytopenia, impairs initial platelet plug formation and slows the coagulation cascade, causing prolonged bleeding from minor vascular injuries due to defective blood clot formation.

155. (B) Blood carries metabolic wastes like urea to kidneys for filtration
The circulatory system and excretory system interact closely as blood acts as the transport medium for metabolic wastes. Renal arteries transport systemic blood containing nitrogenous

wastes, like urea produced by liver metabolism, directly to kidney nephrons, where ultrafiltration removes toxic wastes while retaining essential nutrients and blood proteins.

156. (D) Root pressure at night or early morning
Guttation is the exudation of liquid water droplets from specialized leaf hydathodes, occurring primarily at night or early morning. During these times, high atmospheric humidity and closed stomata halt transpiration, while continuous active root mineral absorption generates positive hydrostatic root pressure that forces xylem water out through hydathode pores.

157. (A) Lymphocytes
Lymphocytes are specialized white blood cells that play a central role in adaptive immunity. B-lymphocytes differentiate into plasma cells that synthesize and secrete specific antibody proteins into blood and lymph. These antibodies bind targeted foreign antigens, neutralizing bacterial toxins and marking pathogenic microbes for destruction by phagocytes.

158. (D) Energy in the form of ATP
Loading sucrose into phloem sieve elements from photosynthetic mesophyll cells requires active transport against concentration gradients. Proton pumps in companion cell membranes expend cellular energy derived from adenosine triphosphate hydrolysis to co-transport sucrose molecules into sieve tubes, raising osmotic pressure to drive phloem sap translocation.

159. (B) Antigens
ABO blood types are determined by specific surface glycoprotein marker molecules called antigens, located on red blood cell membranes. Inherited genes dictate the expression of antigen A, antigen B, both, or neither on erythrocyte surfaces, establishing individual ABO blood group classifications and governing immune compatibility during blood transfusions.

160. (A) I, II, and III only
Arteries lack valves, while veins feature one-way internal valves and carry blood toward the heart. Capillaries enable material exchange across single-celled walls. However, statement IV is incorrect because the pulmonary artery is an exception that carries deoxygenated blood from the right ventricle directly to the lungs.

161. (D) Artery
When a doctor palpates a patient's pulse at the wrist, they compress the radial artery against underlying bone. Arteries expand and recoil rhythmically with each wave of high-pressure blood ejected by left ventricular contraction during cardiac systole, making arterial pulse points ideal for clinical evaluation of heart rate.

162. (A) Phloem transport is bidirectional, while xylem transport is unidirectional
Phloem translocates organic nutrients bidirectionally between photosynthetic sources and metabolic sinks based on plant growth needs. In contrast, xylem conducts water and dissolved mineral ions in a strictly unidirectional upward path from root hairs to aerial leaves, driven by passive root pressure and evaporative transpiration pull mechanisms.

163. (B) Water evaporation at stomata
Evaporation of water vapor through stomatal pores into the atmosphere creates negative hydrostatic pressure tension within leaf mesophyll air spaces. Because water molecules exhibit strong cohesive attraction, this tension generates a continuous upward force—transpiration pull—that draws water columns through xylem conduits from root tissues to upper leaves.

164. (D) Tissue fluid
Tissue fluid, or interstitial fluid, is formed when hydrostatic pressure forces water, small solutes, and amino acids out of blood capillaries into intercellular spaces. Surrounding tissue cells, it facilitates nutrient and gas exchange before draining into lymphatic capillaries to become lymph or returning directly to venous capillary networks.

165. (D) Oxygenated blood from the lungs
The left atrium receives oxygenated blood returning from alveolar capillaries in the lungs via four pulmonary veins. When filled, the left atrium contracts, passing oxygen-rich blood through the bicuspid valve into the left ventricle, which then propels it through the aorta into systemic circulation across the body.

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166. (B) Iron
Iron is a vital mineral constituent required for synthesizing functional haemoglobin molecules inside red blood cells. A diet lacking sufficient iron reduces haemoglobin synthesis and erythrocyte

formation, leading to iron-deficiency anaemia. This condition decreases overall blood oxygen-carrying capacity, impairing aerobic metabolism and causing physical fatigue.

167. (D) Pulmonary circulation
Pulmonary circulation is the closed vascular pathway transporting deoxygenated blood from the right ventricle through pulmonary arteries to the lungs. After releasing carbon dioxide and picking up oxygen in alveolar capillaries, oxygenated blood returns through pulmonary veins into the left atrium of the heart, completing the respiratory circulatory circuit.

168. (C) Both upward and downward directions
Translocation of organic food in phloem tissue occurs bidirectionally throughout the plant body. Photosynthetic leaves produce sucrose, which moves upward toward growing terminal buds, flowers, and developing fruits, or downward toward root storage tissues, depending on seasonal metabolic requirements and sink demand across different plant organs.

169. (B) Converts prothrombin to active thrombin
Thromboplastin, or tissue factor, is a essential protein factor released by damaged tissue cells and activated blood platelets following vascular injury. In the presence of calcium ions, thromboplastin initiates enzymatic reactions that convert inactive plasma prothrombin into active thrombin, driving the coagulation cascade to form a protective blood clot.

170. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Veins contain internal flap valves situated along their length to prevent backward flow of blood. Because venous blood moves under reduced pressure and against gravitational resistance, these one-way valves close under reverse pressure, ensuring unidirectional venous blood flow toward the heart and making the reasoning statement factually correct.

171. (D) Tracheids and vessels
Tracheids and xylem vessel elements form the continuous, non-living tubular network responsible for water transport in vascular plants. At functional maturity, these elongated cells lose their cytoplasm and develop heavily lignified secondary cell walls, creating open hollow conduits optimized for conducting water and mineral ions upward under tension.

172. (A) Liquid medium suspending blood cells
Plasma is the fluid extracellular matrix of blood that suspends cellular elements, including erythrocytes, leukocytes, and platelets. Accounting for approximately 55 percent of total blood volume, plasma consists of 90 percent water and 10 percent dissolved proteins, electrolytes, nutrients, and metabolic wastes, facilitating systemic chemical transport.

173. (B) Water transport will drastically decrease
Coating plant leaf stomata with petroleum jelly blocks microscopic pores, preventing water evaporation into the atmosphere. This blockage halts transpiration, eliminating transpiration pull within leaf mesophyll tissue. Without this negative pressure force, upward transport of water and dissolved mineral ions through xylem vessels decreases drastically throughout the plant.

174. (D) Diffusion
Oxygen moves from pulmonary alveoli into surrounding capillary blood via simple passive diffusion down its partial pressure gradient. Alveolar air contains a higher partial pressure of oxygen than deoxygenated capillary blood, driving dissolved oxygen molecules across thin alveolar and capillary membranes into blood plasma without cellular energy expenditure.

175. (A) I, II, III, IV
Deoxygenated blood returning from systemic body tissues flows through the superior and inferior venae cavae into the right atrium. Upon atrial contraction, blood passes into the right ventricle. Ventricular systole then propels deoxygenated blood into the pulmonary artery, which conducts it to the lungs for gas exchange.

176. (C) Group O - Both Anti-A and Anti-B antibodies
Individuals with blood group O lack both A and B glycoprotein antigens on their red blood cell surface membranes. Because these antigens were absent during immune development, their plasma naturally contains both anti-A and anti-B antibodies, which agglutinate foreign red blood cells expressing A or B surface antigens.

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177. (D) Arteries
Hydrostatic blood pressure is highest in major systemic arteries, particularly near the heart during left ventricular systole. Ejection of blood into the aorta creates significant pressure waves against thick arterial walls. As blood flows through arterioles, capillaries, and veins, frictional resistance progressively reduces blood pressure toward minimal levels.

178. (A) Xylem relies on physical forces; phloem requires active energy (ATP)
Xylem transports water and dissolved mineral salts passively, relying on physical forces like transpiration pull and root pressure across non-living conducting cells. Conversely, phloem translocates organic sucrose through living sieve tubes via active transport, expending metabolic energy in the form of ATP to establish hydrostatic pressure gradients.

179. (B) Coronary artery
The coronary arteries branch directly from the base of the ascending aorta, supplying oxygenated blood to the cardiac muscle wall. This dedicated vascular supply delivers oxygen and nutrient molecules required for continuous myocardial energy metabolism, ensuring sustained cardiac contraction and preventing ischemic tissue damage or cardiac failure.

180. (A) P-3, Q-1, R-4, S-2
Systole is the active contraction phase of cardiac chambers. Diastole represents the relaxation and filling phase of the cardiac cycle. Pulse is the rhythmic arterial expansion felt as blood is ejected from the heart. A sphygmomanometer is the medical diagnostic instrument used to record arterial blood pressure.

181. (B) Tachycardia
Tachycardia is the medical term for an abnormally elevated resting heart rate exceeding 100 beats per minute in an adult. Driven by factors like fever, stress, or cardiac pathology, tachycardia indicates increased sinoatrial node firing, causing elevated heart rate compared to normal resting parameters of 60 to 100 beats per minute.

182. (B) Twice to complete one cycle
In double circulation, blood passes through the four chambers of the heart twice during a single complete circuit through the body. Deoxygenated blood enters the right cardiac chambers and is pumped to the lungs, while oxygenated blood returns to the left chambers before being ejected into systemic circulation.

183. (D) O
Blood group O is designated as the universal donor type because its red blood cells lack both A and B surface antigens. Transfusing group O red cells into recipients of any ABO group does not trigger antibody-mediated agglutination or destruction, making group O safe for emergency red cell transfusions.

184. (A) Transpiration pull
In tall trees like eucalyptus, transpiration pull is the primary driver of upward water transport. Evaporation of water from leaf stomata generates negative hydrostatic pressure tension in mesophyll tissues, pulling unbroken cohesive water columns through xylem conduits from deep root systems to high leaf canopies across extreme vertical distances.

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185. (B) Serum
Serum is the clear, pale-yellow liquid that separates from blood after coagulation completes inside a test tube. Lacking red blood cells, white blood cells, platelets, and fibrinogen consumed during clot formation, serum retains dissolved electrolytes, antibodies, albumin, and metabolic waste products, making it useful for blood biochemistry testing.

186. (B) Bicuspid (mitral) valve
The bicuspid valve, also known as the mitral valve, is situated between the left atrium and left ventricle of the heart. Composed of two flexible fibrous leaflets, it opens to allow oxygenated blood flow into the left ventricle and snaps shut during ventricular systole, preventing backflow into the atrium.

187. (C) Osmosis
Water absorbed by root hairs moves cell-to-cell across the root cortex toward central xylem vessels primarily via osmosis. Accumulation of mineral ions creates a solute gradient across cortical cell layers, driving water passively along a water potential gradient from epidermal root hairs through cortical parenchyma cells into the endodermis.

188. (C) Platelets
Platelets are small cellular fragments in circulating blood essential for hemostasis.

Following vascular injury, platelets adhere to exposed subendothelial collagen, change shape, and aggregate to form a mechanical platelet plug. They release clotting factors that trigger fibrin formation, reinforcing the plug to prevent blood loss from damaged blood vessels.

189. (C) 140/90 mm Hg
Hypertension is clinically diagnosed when resting arterial blood pressure persistently measures at or above 140/90 millimeters of mercury. Chronic blood pressure elevation above this threshold increases mechanical strain on arterial walls and cardiac muscle, raising long-term risk for cardiovascular disease, kidney damage, and vascular rupture.

190. (A) I and II only
Osmosis involves water solvent movement across a selectively permeable membrane, while diffusion occurs spontaneously in solids, liquids, and gases down concentration gradients. Neither process requires metabolic ATP expenditure, as both are passive physical phenomena, making statement III factually incorrect regarding cellular transport mechanisms in biological systems.

191. (B) Filtering bacteria and foreign matter from lymph
Lymph nodes are encapsulated lymphoid organs positioned along lymphatic vessels that filter circulating lymph fluid. Housed macrophages and lymphocytes phagocytose bacteria, cellular debris, and foreign antigens from lymph before it returns to venous blood, helping prevent the systemic spread of infectious pathogens throughout the human body.

192. (D) Loss of turgor pressure in cells
Wilting occurs when transpiration water loss exceeds root water absorption, causing plant mesophyll and parenchymal cells to lose water. As cellular water volume decreases, internal turgor pressure against cell walls drops. Lacking structural support from cell turgidity, leaves and non-woody stems droop, characteristic of water stress in plants.

193. (C) 120 days
Human red blood cells have an average circulating lifespan of approximately 120 days. Lacking nuclei and organelles, mature erythrocytes cannot synthesize new structural proteins or repair cellular damage. Aging red blood cells are removed from circulation and broken down by macrophages in the spleen, liver, and bone marrow for iron recycling.

194. (C) Right atrium
The tricuspid valve is situated between the right atrium and right ventricle of the heart. If its flexible cusps are structurally damaged, elevated fluid pressure during right ventricular contraction forces blood backward through the incomplete seal into the receiving right atrium, reducing forward ejection through the pulmonary artery.

195. (A) I, II, and III only
Hypertension involves elevated arterial pressure that can damage blood vessels, and heart attacks occur when coronary arteries become blocked. A heart attack involves myocardial tissue ischemia rather than complete cessation of cardiac electrical beating—which describes cardiac arrest—making statement IV factually incorrect regarding cardiovascular disease definitions.

196. (C) Provide immunity
White blood cells, or leukocytes, defend the body against infectious diseases and foreign invaders. Specialized leukocyte subtypes neutralize bacterial toxins, produce targeted antibodies, and engulf cellular debris via phagocytosis. Their primary physiological role is maintaining immune defense and protecting tissues against pathogenic micro-organisms throughout human organ systems.

197. (A) It requires ATP
Phloem translocation requires metabolic energy to transport sucrose from source leaves to sink organs. Companion cells use ATP-driven proton pumps to load sucrose into living sieve tube elements against concentration gradients. This active loading increases hydrostatic pressure, driving fluid mass flow bidirectionally through phloem conduits throughout the plant body.

198. (B) Water molecules and each other
In the cohesion-tension theory of plant sap ascent, "cohesion" refers specifically to the mutual intermolecular attraction between polar water molecules due to extensive hydrogen bonding. This cohesive property allows water within xylem conduits to sustain high tension without breaking, forming unbroken liquid columns pulled upward from roots to leaf stomata.

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199. (B) Yellowish fluid left when blood cells are removed

Plasma is the straw-colored extracellular fluid matrix of blood remaining after all cellular elements—erythrocytes, leukocytes, and platelets—are removed. Accounting for roughly 55 percent of blood volume, plasma consists primarily of water containing dissolved proteins, mineral salts, glucose, and nitrogenous metabolic waste products in dynamic balance.

200. (B) Root storage tissues

During early spring growth, newly emerging leaf buds act as metabolic sinks requiring organic energy before becoming photosynthetically active. Stored starches in root parenchyma tissues are hydrolyzed into soluble sucrose and loaded into phloem sieve tubes, acting as the primary source of translocated food to support early shoot development.

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CHAPTER 04

Excretion

1. What is the biological process involved in the removal of harmful metabolic wastes from the body called?
(A) Excretion
(B) Respiration
(C) Nutrition
(D) Reproduction

2. Which of the following is considered a metabolic waste product in humans?
(A) Undigested food
(B) Oxygen
(C) Urea
(D) Glycogen

3. What is the main difference between excretion and defecation?
(A) Excretion removes metabolic wastes, whereas defecation removes undigested food.
(B) Excretion removes undigested food, whereas defecation removes metabolic waste.
(C) Both processes remove the exact same type of waste.
(D) Excretion happens in plants only, whereas defecation happens in animals only.

4. Animals that excrete ammonia as their primary nitrogenous waste are known as:
(A) Ureotelic
(B) Uricotelic
(C) Aminotelic
(D) Ammonotelic

5. Which of the following groups of animals is primarily uricotelic?
(A) Mammals and amphibians
(B) Birds and reptiles
(C) Bony fishes and aquatic insects
(D) Humans and earthworms

6. The primary nitrogenous waste excreted by human beings is:
(A) Ammonia
(B) Uric acid
(C) Urea
(D) Amino acids

7. Ammonia is highly toxic and requires a large amount of water for its elimination. Which animals predominantly excrete ammonia?
(A) Desert-dwelling lizards
(B) Terrestrial mammals
(C) Flying avian species
(D) Aquatic bony fishes

8. In the human excretory system, which organ filters the blood to produce urine?
(A) Kidney
(B) Ureter
(C) Urinary bladder
(D) Urethra

9. Where are the kidneys located in the human body?
(A) In the upper thoracic cavity, behind both lungs
(B) In the abdominal cavity, beside the backbone
(C) Inside the lower pelvic cavity, below the bladder
(D) In the anterior lower region of the neck

10. Select the correct sequence of organs in the human excretory system through which urine passes:
(A) Kidney, Urinary bladder, Ureter, Urethra
(B) Kidney, Ureter, Urinary bladder, Urethra
(C) Ureter, Kidney, Urinary bladder, Urethra
(D) Kidney, Urethra, Urinary bladder, Ureter

11. What is the tube-like structure that carries urine from the kidney to the urinary bladder?
(A) Ureter
(B) Urethra
(C) Nephron
(D) Collecting duct

12. Which structure temporarily stores urine until it is excreted from the body?
(A) The kidney organ
(B) The gall bladder
(C) Urinary bladder
(D) The ureter tubes

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13. Through which passage is urine finally released from the body?
(A) Ureter
(B) Nephron
(C) Renal vein
(D) Urethra

14. The outer region of the internal structure of the kidney is called the:
(A) Medulla
(B) Pelvis
(C) Cortex
(D) Nephron

15. Read the following statements regarding the human urinary bladder:
Assertion (A): The human urinary bladder is muscular and under nervous control.
Reason (R): This allows humans to generally control the urge to urinate.
Which of the following options is correct?
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

16. The inner region of the kidney, which is divided into conical masses, is known as the:
(A) Renal cortex
(B) Renal pelvis
(C) Renal capsule
(D) Renal medulla

17. The funnel-shaped inner space of the kidney where urine collects before entering the ureter is the:
(A) Renal pelvis
(B) Cortex
(C) Medulla
(D) Bowman's capsule

18. What is the basic filtration and functional unit of the human kidney?
(A) Neuron
(B) Alveolus
(C) Nephron
(D) Villi

19. The cup-shaped upper end of a nephron is called:
(A) Bowman's capsule
(B) The glomerulus
(C) The loop of Henle
(D) The collecting duct

20. Determine the correct order of the primary stages of urine formation:
1. Tubular secretion
2. Glomerular filtration
3. Tubular reabsorption
(A) 2, 3, 1
(B) 1, 2, 3
(C) 3, 2, 1
(D) 2, 1, 3

21. What is the network of capillaries enclosed within the Bowman's capsule called?
(A) Renal artery
(B) Glomerulus
(C) Vasa recta
(D) Peritubular capillaries

22. In which part of the nephron does ultrafiltration of blood take place?
(A) Loop of Henle hairpin structure
(B) Renal collecting duct system
(C) Glomerulus and Bowman's capsule
(D) Distal convoluted tubule region

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23. During urine formation, useful substances like glucose, amino acids, and water are reabsorbed into the blood. Where does this primarily occur?
(A) Bowman's capsule
(B) Renal pelvis space
(C) Ureter pathway
(D) Renal tubule

24. Which of the following is normally NOT filtered out of the blood into the Bowman's capsule?
(A) Red blood cells
(B) Nitrogenous urea
(C) Free water molecules
(D) Blood glucose sugar

25. Match the terms in List I with their corresponding descriptions or organisms in List II.
List I: Excretory Terms
P. Ammonotelic
Q. Ureotelic
R. Uricotelic
S. Osmoregulation
List II: Description/Organism
1. Human beings
2. Maintenance of water and salt balance
3. Birds and reptiles
4. Bony fishes
(A) P-1, Q-4, R-2, S-3
(B) P-4, Q-1, R-3, S-2
(C) P-4, Q-3, R-1, S-2

(D) P-3, Q-1, R-4, S-2

26. Which stage of urine formation involves the active removal of certain wastes like extra salts and drugs directly from blood into the tubule?
(A) Filtration
(B) Secretion
(C) Reabsorption
(D) Micturition

27. What is the average percentage of water in normal human urine?
(A) 50%
(B) 75%
(C) 95%
(D) 99%

28. Apart from water, what is the major solid component dissolved in normal human urine?
(A) Glucose
(B) Proteins
(C) Urea
(D) Red blood cells

29. The presence of which substance in urine strongly indicates diabetes or a high blood sugar level?
(A) Urea
(B) Sodium chloride
(C) Uric acid
(D) Glucose

30. The procedure used to clean the blood of a person with kidney failure is called:
(A) Pacemaker implantation
(B) Angioplasty
(C) Hemodialysis
(D) Electrocardiography

31. What acts as an artificial kidney in patients suffering from severe renal failure?
(A) Mechanical ventilator
(B) Dialysis machine
(C) Cardiac defibrillator
(D) Coronary stent

32. Which of the following processes does NOT occur in an artificial kidney (dialysis) but does occur in a normal healthy kidney?
(A) Removal of urea
(B) Filtration of blood
(C) Separation of excess salts
(D) Selective reabsorption

33. The dialysis fluid used in an artificial kidney has the same osmotic pressure as blood, except that it lacks:
(A) Nitrogenous wastes
(B) Dissolved glucose
(C) Essential amino acids
(D) Inorganic sodium chloride

34. What is the ultimate medical solution for a patient whose both kidneys have permanently failed?
(A) Continuous antibiotics
(B) Removing the bladder
(C) Kidney transplantation
(D) Drinking more water

35. Consider the following statements about kidney transplantation:
I. It involves placing a healthy kidney from a donor into the patient.
II. A close relative is usually preferred to reduce the chances of organ rejection.
III. The patient's old non-functioning kidneys must always be removed immediately.
Which of the above statement(s) is/are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II, and III

36. Apart from the kidneys, which other organ helps in excretion by eliminating water and some salts through sweat?
(A) Liver
(B) Heart
(C) Stomach
(D) Skin

37. Sweat glands in the human skin are primarily meant for thermoregulation, but they also help excrete:
(A) Large amounts of metabolic urea
(B) Traces of water and salts
(C) Dissolved carbon dioxide gas
(D) Bulk undigested food roughage

38. Which gaseous waste is excreted by the human lungs?
(A) Molecular oxygen
(B) Atmospheric nitrogen
(C) Carbon dioxide
(D) Gaseous ammonia

39. In the human body, the lungs act as excretory organs by eliminating carbon dioxide and:

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(A) Urea
(B) Excess glucose
(C) Bile pigments
(D) Water vapour

40. Which organ in the human body is responsible for converting highly toxic ammonia into less toxic urea?
(A) Liver
(B) Kidney
(C) Lung
(D) Spleen

41. The biochemical pathway in the liver that converts ammonia and carbon dioxide into urea is known as the:
(A) Krebs cycle
(B) Urea cycle
(C) Calvin cycle
(D) Nitrogen cycle

42. Bile pigments (bilirubin and biliverdin), which are excretory products formed from the breakdown of old red blood cells, are produced in the:
(A) Kidney
(B) Liver
(C) Pancreas
(D) Small intestine

43. How do plants rid themselves of gaseous waste products like oxygen (during the day) and carbon dioxide (at night)?
(A) Stomata and lenticels
(B) Through root hairs in the soil
(C) Through vascular xylem vessels
(D) Through outer bark tissues only

44. Plants can store some of their waste products in cellular parts that eventually fall off. Which of the following is an example of this?
(A) Growing stem
(B) Root tips
(C) Old leaves
(D) Fresh flowers

45. Read the following statements regarding excretion in plants:
I. Plants do not have specialized excretory organs like kidneys.
II. Plants excrete excess water by transpiration.
III. Waste products may be stored in vacuoles.
IV. Plants produce urea as their primary nitrogenous waste.
Which of the above statement(s) is/are correct?
(A) II, III, and IV
(B) I, III, and IV
(C) I, II, and IV
(D) I, II, and III

46. Gums and resins are waste products of plants. In which part of the plant are they mostly stored?
(A) Phloem
(B) Chloroplasts
(C) Old xylem
(D) Root hairs

47. Tannins, which are commonly found in the bark of trees, serve primarily as:
(A) Essential nutrients for tree growth
(B) Stored plant waste products
(C) Primary photosynthetic pigments
(D) Regulatory hormones for growth

48. Some plants excrete waste substances into the soil around them. This statement is:
(A) True for all plants
(B) False for all plants
(C) Only true for aquatic plants
(D) True for some plants

49. Aquatic animals like fish excrete ammonia directly into the surrounding water. Why is this possible?
(A) Ammonia is soluble in water and diffuses across gills.
(B) Ammonia is completely insoluble in aquatic water environments.
(C) Fish possess specialized huge kidneys that continuously store ammonia.
(D) Ammonia rapidly converts into an insoluble solid precipitate in water.

50. Select the correct order of the pathway of blood to be filtered in the human kidney:
(A) Renal vein → Glomerulus → Renal artery
(B) Glomerulus → Renal artery → Renal vein
(C) Renal artery → Glomerulus → Renal vein
(D) Renal artery → Renal vein → Glomerulus

51. A common excretory system disorder resulting in the formation of hard crystal deposits in the kidney is called:
(A) Kidney stones
(B) Hepatic jaundice
(C) Bronchial asthma
(D) Liver cirrhosis

52. Kidney stones are most commonly formed from the crystallization of which salts in the urinary tract?

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(A) Sodium chloride salt
(B) Potassium iodide compound
(C) Hydrated iron sulphate
(D) Calcium oxalate

53. UTI is a common disease associated with the excretory system. What does UTI stand for?
(A) Urea Treatment Indicator
(B) Urinary Tract Infection
(C) Urinary Tubule Inflammation
(D) Uric Tract Impairment

54. Which of the following is a primary function of the kidneys besides removing nitrogenous waste?
(A) Digestion of dietary proteins
(B) Production of hepatic bile
(C) Osmoregulation
(D) Pumping oxygenated blood to lungs

55. Read the following statements regarding human urine production:
Assertion (A): The amount of urine produced by a person increases in summer compared to winter.
Reason (R): In summer, a lot of water is lost from the body through sweat.
Which of the following options is correct?
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

56. The process of regulating the amount of water and dissolved salts in the blood and body fluids is called:
(A) Osmoregulation
(B) Thermoregulation
(C) Autoregulation
(D) Transpiration

57. Which biological system works most closely with the excretory system to transport waste from cells to the kidneys?
(A) Human skeletal system
(B) Circulatory system
(C) Central nervous system
(D) Somatic muscular system

58. The hormone responsible for regulating water reabsorption in the distal parts of the nephron is:
(A) Pancreatic hormone insulin
(B) Antidiuretic hormone
(C) Thyroid hormone thyroxine
(D) Adrenal hormone adrenaline

59. If the level of ADH (Antidiuretic Hormone) increases in the blood, the amount of water reabsorbed by the kidneys will:
(A) Increase
(B) Decrease
(C) Remain unchanged
(D) Stop completely

60. Arrange the following steps of the urea cycle and elimination in the correct order:
1. Transportation of urea by blood
2. Conversion of ammonia to urea in the liver
3. Excretion of urea in urine
4. Filtration of urea by the kidneys
(A) 2, 1, 4, 3
(B) 1, 2, 4, 3
(C) 2, 4, 1, 3
(D) 4, 3, 2, 1

61. Routine urine testing during health check-ups is important because it can help detect:
(A) The exact blood group and RH factor of a person
(B) Cardiac arrhythmias and valve defects
(C) Total lung capacity and respiratory rate
(D) Kidney disorders or diabetes

62. The presence of excess protein in a routine urine test often indicates a problem with which part of the nephron?
(A) Collecting duct
(B) Loop of Henle
(C) Glomerulus
(D) Renal vein

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63. Proper hydration helps prevent which common excretory disorder?
(A) Lung cancer
(B) Kidney stones
(C) Peptic ulcers
(D) Cataracts

64. What is the approximate length of each human kidney?
(A) 2-3 cm
(B) 10-12 cm
(C) 20-25 cm
(D) 30-40 cm

65. Match the plant waste products in List I with their descriptions in List II.
List I: Waste Products
P. Oxygen

Q. Resins
R. Dead leaves
S. Transpiration water

List II: Descriptions

1. Stored in old xylem
2. Loss of excess water vapour
3. Fallen off to remove wastes
4. By-product of photosynthesis

(A) P-4, Q-1, R-3, S-2
(B) P-1, Q-4, R-2, S-3
(C) P-4, Q-3, R-1, S-2
(D) P-2, Q-1, R-3, S-4

66. The colour of normal human urine is slightly yellow due to the presence of a pigment called:
(A) Melanin
(B) Hemoglobin
(C) Urochrome
(D) Chlorophyll

67. The human right kidney is usually located slightly lower than the left kidney. This is due to the presence of which organ above it?
(A) Liver
(B) Stomach
(C) Spleen
(D) Heart

68. The functional relationship between the transport system and the excretory system is best described by which statement?
(A) Kidneys directly synthesize red blood cells to supply the entire transport system.
(B) Kidneys assist in digesting food particles while the transport system distributes them.
(C) The transport system continuously filters liquid urine before it enters the bladder.
(D) It transports metabolic wastes from body cells to the kidneys.

69. Which of the following is an INCORRECT pair?
(A) Sweating - Skin
(B) Urea formation - Kidney
(C) Carbon dioxide removal - Lungs
(D) Filtration of blood - Nephron

70. Find the odd one out based on human excretory organs:
(A) Liver
(B) Kidney
(C) Heart
(D) Skin

71. Identify the INCORRECT statement about human kidneys.
(A) They are bean-shaped.
(B) They are located in the abdominal cavity.
(C) They contain millions of nephrons.
(D) They produce bile pigments.

72. During hemodialysis, the patient's blood is pumped into the dialyzer, and to prevent blood clotting, a substance is added. Which natural anticoagulant is typically used or mimics this function?
(A) Heparin
(B) Hemoglobin
(C) Histamine
(D) Insulin

73. What role does the renal vein play in the excretory system?
(A) It brings oxygenated blood loaded with waste to the kidney.
(B) It takes deoxygenated, filtered blood away from the kidney.
(C) It carries urine to the bladder.
(D) It absorbs water from the large intestine.

74. Which of the following best defines tubular secretion?
(A) Active movement of water from the renal tubule back into the blood capillaries
(B) Movement of wastes from blood into the renal tubule
(C) Continuous pumping of arterial blood directly into the glomerulus structure
(D) Hydrostatic flow of formed liquid urine from collecting ducts into ureters

75. Consider the following statements about osmoregulation:
I. It ensures the water content in the body remains constant.
II. The kidneys play the primary role in this process in humans.
III. It regulates the concentration of mineral salts in the blood.
Which of the above statement(s) is/are correct?
(A) I, II, and III
(B) I and II only
(C) II and III only
(D) I and III only

76. In an earthworm, the main excretory organs are called:
(A) Flame cells
(B) Malpighian tubules
(C) Nephridia

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(D) Kidneys

77. Which structure acts as the primary excretory organ in insects like cockroaches?
(A) Renal nephrons system
(B) Vertebrate kidneys
(C) Aquatic gills
(D) Malpighian tubules

78. Which of the following diseases is characterised by inflammation of the urinary bladder?
(A) Nephritis
(B) Uremia
(C) Cystitis
(D) Bronchitis

79. The condition where high amounts of urea accumulate in the blood due to kidney failure is called:
(A) Anemia
(B) Uremia
(C) Glycosuria
(D) Hematuria

80. Why is excretion considered a vital life process?
(A) It provides essential biochemical energy to the body.
(B) It helps in digesting consumed food materials faster.
(C) It directly regulates somatic body movement and posture.
(D) It prevents toxic waste accumulation.

81. In the structure of a nephron, the Bowman's capsule continues into a long tubular structure. The U-shaped part of this tubule is known as:
(A) Loop of Henle
(B) Distal tubule
(C) Proximal tubule
(D) Collecting duct

82. Which of the following is the most appropriate step for preventing kidney stones?
(A) Drinking less water to rest and protect the kidneys
(B) Voluntarily holding urine for extended time periods
(C) Drinking sufficient water daily
(D) Eating excessive amounts of refined dietary salt

83. The process by which aquatic plants remove metabolic wastes directly into the water is primarily:
(A) Diffusion
(B) Transpiration
(C) Guttation
(D) Active transport

84. Which metabolic waste is primarily derived from the breakdown of proteins and amino acids?
(A) Gaseous carbon dioxide
(B) Excess cellular water
(C) Dissolved glucose sugar
(D) Nitrogenous wastes

85. Read the following statements about the liver's role in excretion:
I. It breaks down excess amino acids.
II. It converts ammonia to urea.
III. It forms bile pigments from destroyed red blood cells.
IV. It filters urea out of the blood to form urine.
Which of the above statement(s) is/are correct?
(A) II, III, and IV
(B) I, II, and III
(C) I, III, and IV
(D) I, II, III, and IV

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86. Which blood vessel supplies dirty (waste-laden), oxygenated blood to the kidney?
(A) Renal vein
(B) Hepatic portal vein
(C) Renal artery
(D) Pulmonary artery

87. A person passes frequent, diluted urine. A deficiency of which hormone could cause this?
(A) Thyroid thyroxine hormone
(B) Pancreatic hormone insulin
(C) Steroid testosterone hormone
(D) Antidiuretic hormone

88. Defecation is the removal of undigested food from the alimentary canal. This waste is technically called:
(A) Faeces
(B) Liquid urine
(C) Skin sweat
(D) Oily sebum

89. Which plant structure is primarily responsible for releasing excess water in the form of liquid drops at the leaf margins (guttation)?
(A) Stomata
(B) Hydathodes
(C) Lenticels
(D) Root hairs

90. Select the correct order of the nephron parts starting from the site of filtration:
(A) Bowman's capsule → Loop of Henle → Proximal tubule → Distal tubule
(B) Bowman's capsule → Proximal tubule → Loop of Henle → Distal tubule
(C) Glomerulus → Distal tubule → Loop of Henle → Proximal tubule
(D) Proximal tubule → Bowman's capsule → Distal tubule → Loop of Henle

91. The amount of water reabsorbed by the kidneys depends on:
(A) How much excess water is present in the body
(B) How much dissolved waste needs to be excreted
(C) Both (A) and (B)
(D) The amount of solid food eaten

92. What is the approximate volume of initial filtrate produced daily in a healthy human adult?
(A) 1-2 litres
(B) 10-20 litres
(C) 90-100 litres
(D) 180 litres

93. Even though 180 litres of initial filtrate is formed daily, humans excrete only about 1-2 litres of urine. What explains this?
(A) Most of the fluid filtrate rapidly evaporates through skin pores.
(B) The human urinary bladder cannot physically store 180 litres of fluid.
(C) The filtered liquid is temporarily stored inside the human liver.
(D) Most filtrate is reabsorbed by tubules.

94. The continuous process of blood purification by the kidneys ensures that blood composition remains stable. This stability is an example of:
(A) Haemolysis
(B) Haemopoiesis
(C) Homeostasis
(D) Heterotrophy

95. Read the following statements regarding dialysis:
Assertion (A): Dialysis is known as an artificial kidney.
Reason (R): Dialysis permanently cures kidney failure and restores normal kidney function.
Which of the following options is correct?
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

96. Maintaining general hygiene of the excretory system, specifically the external genital areas, helps prevent:
(A) Renal kidney stones
(B) Chronic liver cirrhosis disease
(C) Acute heart attacks
(D) Urinary tract infections

97. The presence of red blood cells in urine is an abnormal condition known as:
(A) Hematuria
(B) Glycosuria
(C) Uremia
(D) Ketonuria

98. Which layer of the kidney surrounds and protects it from external shocks?
(A) Outer renal cortex
(B) Inner renal pelvis
(C) Renal capsule
(D) Fibrous peritoneum

99. Ureters open into the urinary bladder through:
(A) Two separate openings
(B) A single common opening
(C) A network of capillaries
(D) The urethra

100. Arrange the following parts to trace the path of carbon dioxide excretion:
1. Alveoli
2. Blood stream
3. Trachea
4. Nose
(A) 2, 1, 3, 4
(B) 1, 2, 4, 3
(C) 3, 1, 2, 4
(D) 2, 3, 1, 4

101. Which animal is an example of a ureotelic organism?
(A) Pigeon
(B) Frog
(C) Shark
(D) Insect

102. Which animal is an example of a uricotelic organism?
(A) Human
(B) Fish

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(C) Snake
(D) Frog

103. Uric acid is excreted as a semi-solid white paste by birds and reptiles. What is the primary advantage of this?
(A) It acts as a visual signal that looks attractive to potential mates.
(B) It possesses extremely high solubility in surrounding liquid water.
(C) It provides rich organic nutrients and energy directly to the soil.
(D) It conserves body water during waste excretion.

104. What is the name of the sphincter that controls the release of urine from the urinary bladder?
(A) Urethral sphincter
(B) Stomach pyloric sphincter
(C) Muscular anal sphincter
(D) Oesophageal cardiac sphincter

105. Match the structures in List I with their functions in List II.
List I: Structures
P. Glomerulus
Q. Ureter
R. Bladder
S. Urethra
List II: Functions
1. Transport of urine to outside the body
2. Filtration of blood
3. Transport of urine from kidney
4. Storage of urine
(A) P-3, Q-2, R-1, S-4
(B) P-2, Q-3, R-4, S-1
(C) P-4, Q-1, R-2, S-3
(D) P-2, Q-4, R-3, S-1

106. In plants, cellular waste products can be stored in large:
(A) Nuclei
(B) Vacuoles
(C) Mitochondria
(D) Ribosomes

107. Which of the following substances found in plant leaves helps in storing waste products before the leaf falls?
(A) Calcium oxalate
(B) Starch molecules
(C) Leaf chlorophyll pigments
(D) Dissolved glucose sugar

108. Why is the left kidney slightly higher than the right kidney in humans?
(A) To accommodate the large muscular stomach organ above it
(B) Due to the asymmetrical anatomical position of the heart
(C) Due to the liver on the right side
(D) It represents a completely random genetic evolutionary mutation

109. What acts as the filtering membrane in the Bowman's capsule?
(A) The epithelial walls of the main collecting duct system
(B) The hair-pin loop of Henle tubular structure
(C) The funnel-shaped inner renal pelvis membrane
(D) Glomerular capillary wall

110. Which part of the kidney contains the loop of Henle and the collecting ducts?
(A) Renal cortex
(B) Renal pelvis
(C) Renal medulla
(D) Renal capsule

111. Which part of the kidney contains the glomerulus and Bowman's capsule?
(A) Renal medulla
(B) Renal cortex
(C) Renal pelvis
(D) Ureter

112. Identify the correct pair:
(A) Resin - Human excretion
(B) Dialysis - Liver failure treatment
(C) Defecation - Removal of urea
(D) Urea - Nitrogenous waste

113. If a patient is diagnosed with kidney stones, they may experience severe pain in the:
(A) Lower back and abdomen
(B) Anterior chest wall region
(C) Upper cervical neck
(D) Major skeletal joints

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114. The process of passing urine out of the body is scientifically called:
(A) Deglutition
(B) Mastication
(C) Micturition
(D) Parturition

115. Consider the following statements about urine formation:

I. Glomerular filtration is a non-selective process based on size.
II. Tubular reabsorption is a highly selective process.
III. Tubular secretion adds substances from the filtrate back into the blood.
Which of the above statement(s) is/are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II, and III

116. Ammonia is formed in the human body mainly by the breakdown of:
(A) Carbohydrates
(B) Fatty acids
(C) Vitamins
(D) Amino acids

117. Which of the following indicates an abnormality in kidney function during a urine test?
(A) Presence of metabolic urea
(B) Presence of albumin
(C) Presence of excreted water
(D) Presence of sodium chloride

118. Which structural characteristic of the glomerulus helps in ultrafiltration?
(A) The efferent arteriole leaving the glomerulus is significantly wider than the afferent arteriole entering it.
(B) Both afferent and efferent arterioles possess completely identical vessel lumen diameters throughout.
(C) Afferent arteriole is wider than efferent arteriole.
(D) Glomerular capillaries possess extraordinarily thick, non-porous, impermeable cellular walls.

119. The collecting ducts from numerous nephrons merge to pour urine directly into the:
(A) Urethra
(B) Renal vein
(C) Bowman's capsule
(D) Renal pelvis

120. Which of the following represents an essential measure for maintaining kidney health?
(A) Drinking sufficient water daily
(B) Consuming high amounts of processed salts
(C) Ignoring urinary tract infections
(D) Holding urine for extended periods regularly

121. The main excretory product in human sweat is:
(A) Concentrated uric acid crystals
(B) Water and dissolved salts
(C) Lipids and oily sebum secretions
(D) Free essential amino acids

122. Sweat glands are also known as:
(A) Cutaneous sebaceous glands
(B) Sudoriferous glands
(C) Exocrine salivary glands
(D) Ocular lacrimal glands

123. The relationship between excretion and osmoregulation ensures that:
(A) Blood volume and solutes remain constant
(B) Human body core temperature is maintained strictly at 37°C throughout
(C) Ingested organic food material is completely and fully digested
(D) Cellular oxygen is efficiently delivered to all peripheral tissues

124. Which of the following is considered an accessory excretory organ in humans?
(A) Heart
(B) Small intestine
(C) Skin
(D) Brain

125. Read the following statements regarding dialysis:
I. It removes urea and excess salts from the blood.
II. Blood is passed through tubes with semi-permeable walls.
III. The dialysing fluid contains no nitrogenous wastes initially.
IV. Dialysis machines perform active reabsorption of glucose.
Which of the above statement(s) is/are correct?
(A) II, III, and IV
(B) I, III, and IV
(C) I, II, and IV
(D) I, II, and III

126. A person suffering from severe kidney failure requires dialysis. How often is hemodialysis typically performed for such patients?
(A) Once a year
(B) Once every 6 months
(C) 2-3 times a week
(D) Once in a lifetime

127. Plant cells often convert toxic waste substances into non-toxic, solid crystals. The most common form of these crystals is:
(A) Inorganic sodium chloride salts

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(B) Calcium oxalate crystals
(C) Crystalline potassium nitrate
(D) Precipitated iron oxide compounds

128. Certain essential oils, like eucalyptus and sandalwood oil, are actually:
(A) Toxic nitrogenous wastes of plants
(B) Inorganic minerals absorbed from soil
(C) Essential photosynthetic pigments
(D) Plant excretory products

129. How do single-celled organisms like Amoeba primarily excrete their metabolic wastes?
(A) Simple diffusion across cell surface
(B) By utilizing a highly complex internal kidney organ system
(C) Through specialized excretory structures called malpighian tubules
(D) By releasing liquid droplets through the process of guttation

130. The contractile vacuole in Amoeba is primarily responsible for:
(A) Intracellular food digestion
(B) Pseudopodial cell locomotion
(C) Osmoregulation
(D) Asexual cell reproduction

131. In the context of the urea cycle, where is the urea released directly into the bloodstream?
(A) From the liver
(B) From the kidney
(C) From the lungs
(D) From the bladder

132. What causes the distinct, pungent smell often associated with public urinals?
(A) Accumulation of uric acid
(B) Presence of excess glucose in urine
(C) Freshly excreted nitrogenous urea
(D) Ammonia from urea breakdown

133. Which physical property of water makes it an excellent medium for excretion of wastes?
(A) Remarkably high specific heat capacity
(B) It is a universal solvent
(C) Extremely low relative boiling point
(D) Unusually high physical freezing point

134. Identify the odd one out based on the type of nitrogenous waste excreted:
(A) Pigeon
(B) Sparrow
(C) Frog
(D) Lizard

135. Read the following statements regarding aquatic animal excretion:
Assertion (A): Aquatic animals like bony fishes are primarily ammonotelic.
Reason (R): Ammonia is highly soluble in water and readily diffuses into the surrounding water.
Which of the following options is correct?
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

136. Which structural component prevents urine from flowing backward from the bladder into the ureters?
(A) Valves between ureters and bladder
(B) Downward gravitational pull and intra-abdominal hydrostatic force only
(C) Muscular contractions of the external urethral sphincter
(D) Continuous fluid reabsorption inside the loop of Henle

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137. Which human organ acts as the central control for checking and regulating the concentration of water in the blood?
(A) Heart
(B) Kidney
(C) Pancreas
(D) Gall bladder

138. High blood pressure can damage the delicate capillaries in which part of the excretory system?
(A) Ureter
(B) Glomerulus
(C) Bladder
(D) Renal pelvis

139. The breakdown of purines and pyrimidines (nucleic acids) in humans primarily yields which waste product, often associated with gout?
(A) Uric acid
(B) Urea
(C) Ammonia
(D) Creatinine

140. Which of the following is NOT an excretory product of plants?
(A) Gum
(B) Resin
(C) Urea
(D) Essential oil

141. The condition of frequent, burning urination is a common symptom of:
(A) Chronic renal kidney failure
(B) Hemodialysis procedure
(C) Osmoregulation system failure
(D) Urinary tract infection

142. A healthy adult typically passes how much urine in 24 hours?
(A) Exactly 0.5 litre
(B) 1 to 1.5 litres
(C) Approximately 4 to 5 litres
(D) Exactly 10 litres

143. If a person drinks copious amounts of water, what will happen to the urine produced?
(A) It will become highly concentrated, dark yellow, and acidic.
(B) It will be pale, dilute, and abundant.
(C) It will contain significantly higher concentration levels of urea.
(D) Urine production process will temporarily stop completely.

144. Which part of the brain monitors the water content in the blood and signals the release of ADH?
(A) Cerebellum
(B) Medulla oblongata
(C) Cerebrum
(D) Hypothalamus

145. Match the organs in List I with the excretory products or functions in List II.
List I: Organs
P. Liver
Q. Lungs
R. Skin
S. Kidney
List II: Excretory Products / Functions
1. CO_2 and water vapour
2. Water, salts, and small amounts of urea (sweat)
3. Main filtration of urea and water
4. Conversion of ammonia to urea
(A) P-4, Q-1, R-2, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-4, Q-2, R-1, S-3
(D) P-3, Q-1, R-2, S-4

146. Which group of terrestrial animals excretes mostly solid or semi-solid waste to conserve the maximum amount of water?
(A) Terrestrial mammals
(B) Amphibians like frogs
(C) Birds and reptiles
(D) Segmented earthworms

147. A kidney transplant is most successful when the donor and recipient have:
(A) Matching blood types and tissue types
(B) Completely different genetic backgrounds
(C) The same weight
(D) The same age

148. Immunosuppressive drugs are given to patients after a kidney transplant. Why?
(A) To significantly speed up the rate of urine production
(B) To eliminate and kill pathogenic bacteria in the bladder
(C) To artificially increase systemic arterial blood pressure
(D) To prevent rejection of the new kidney

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149. The liquid that is collected in the Bowman's capsule after ultrafiltration is called:
(A) Concentrated urine
(B) Glomerular filtrate
(C) Clear tissue lymph
(D) Filtered blood plasma

150. Which of the following passes through the filtration slits of the glomerulus into the Bowman's capsule?
(A) Intact red blood cells
(B) Circulating white blood cells
(C) Water and solute salts
(D) Large molecular plasma proteins

151. Why does the glomerulus have high hydrostatic pressure?
(A) Because the cardiac muscle pumps arterial blood with high force directly into the capsule.
(B) Because gravitational forces pull flowing blood downward into renal vessels.
(C) Because antidiuretic hormone rapidly constricts all systemic circulatory vessels.
(D) Efferent arteriole is narrower than afferent arteriole.

152. In a normal healthy individual, the glucose filtered into the Bowman's capsule is:
(A) Reabsorbed in proximal tubule
(B) Excreted completely out of the body through urine
(C) Biologically converted into nitrogenous urea
(D) Temporarily stored inside the renal pelvis

space

153. A decrease in blood pressure or blood volume generally causes the kidneys to:
(A) Rapidly excrete larger volumes of water
(B) Conserve water and concentrate urine
(C) Stop filtration activity completely
(D) Actively excrete excess blood glucose

154. What are the small tubes that carry urine from the kidney to the urinary bladder made of?
(A) Bone
(B) Smooth muscle
(C) Cartilage
(D) Skeletal muscle

155. Consider the following statements concerning the urinary bladder:
I. It is a muscular sac.
II. It is under the voluntary control of the nervous system.
III. It produces urine when water levels are high.
Which of the above statement(s) is/are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II, and III

156. The ureters enter the urinary bladder at its:
(A) Anterior superior surface
(B) Lateral sides halfway up
(C) Posterior base
(D) Apical dome

157. What happens if both kidneys are completely damaged and the patient does not undergo dialysis or a transplant?
(A) The liver takes over kidney functions.
(B) The skin excretes all the urea.
(C) The person continues to live a normal life with more sweating.
(D) Toxic wastes accumulate in the body leading to death.

158. The excretory product commonly seen accumulating on older leaves just before they fall is largely:
(A) Stored excess starch
(B) Active photosynthetic chlorophyll
(C) Toxic metabolic waste
(D) Useful synthesized amino acids

159. When comparing blood entering the kidney (renal artery) with blood leaving the kidney (renal vein), the blood in the renal vein has:
(A) More urea and less oxygen
(B) Less urea and less oxygen
(C) More urea and more oxygen
(D) Less urea and more oxygen

160. Which organ in the human body is NOT traditionally classified as having an excretory role?
(A) Respiratory lungs
(B) Cutaneous skin
(C) Metabolic liver
(D) Thyroid gland

161. Plants excrete excess carbon dioxide primarily during the:
(A) Night
(B) Day
(C) Summer season only
(D) Winter season only

162. How is oxygen, a waste product of photosynthesis, released by plants?
(A) Through the root tips
(B) Through lenticels in stems
(C) Through stomata in leaves
(D) It is not released, it is all stored

163. The functional relationship between excretion and osmoregulation ensures that the osmotic pressure of blood remains isotonic to:
(A) Human body cells
(B) Pure distilled water
(C) Saline ocean seawater
(D) Fresh natural tap water

164. Diuretics are substances that promote the production of urine. Which of the following is a common mild diuretic?
(A) Table salt
(B) Refined sugar
(C) Wholewheat bread
(D) Tea/Coffee

165. Read the following statements about urine testing:
I. It can detect urinary tract infections.
II. It can indicate kidney damage if proteins are present.
III. It can indicate diabetes if glucose is present.
IV. It can measure lung capacity.
Which of the above statement(s) is/are correct?
(A) II, III, and IV
(B) I, II, and III
(C) I, III, and IV
(D) I, II, and IV

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166. A doctor advises a patient with recurrent kidney stones to change their diet. Which of the following changes is most commonly recommended?
(A) Eat more calcium-oxalate rich foods like spinach.
(B) Drink less water to rest the kidneys.
(C) Increase daily water intake significantly.
(D) Consume higher amounts of meat.

167. Which of the following animals is an exception to the general rule and has a mesonephric kidney in its adult stage?
(A) Human
(B) Pigeon
(C) Lizard
(D) Frog

168. Excretion of hypertonic (concentrated) urine in humans is an adaptation to:
(A) Conserve water
(B) Conserve heat
(C) Eliminate excess water
(D) Eliminate excess oxygen

169. What type of epithelium primarily lines the inner surface of the urinary bladder allowing it to stretch?
(A) Simple squamous epithelium
(B) Transitional epithelium
(C) Simple columnar epithelium
(D) Ciliated columnar epithelium

170. Which of the following statements about the urethra is INCORRECT?
(A) It is the tube that carries urine from the bladder to the outside.
(B) It actively reabsorbs water into the blood.
(C) It is longer in males than in females.
(D) In males, it also serves as a passage for semen.

171. In human females, the urethra serves as a common passage for:
(A) Only urine
(B) Urine and reproductive cells
(C) Urine and faeces
(D) Urine and sweat

172. The exact location where blood capillaries empty into the Bowman's capsule is referred to as the:
(A) Renal pelvis
(B) Ureteric bud
(C) Vascular pole
(D) Renal pyramid

173. The inner surface of the kidney features a notch through which the ureter, blood vessels, and nerves enter or exit. This notch is called the:
(A) Calyx
(B) Pelvis
(C) Cortex
(D) Hilum

174. Which part of the renal tubule is found mostly in the renal medulla?
(A) Proximal convoluted tubule
(B) Distal convoluted tubule
(C) Loop of Henle
(D) Bowman's capsule

175. Read the following statements regarding the mechanism of dialysis:
Assertion (A): Dialysis works on the principle of diffusion and osmosis.
Reason (R): Wastes diffuse from higher concentration in blood to lower concentration in dialysing fluid across a semi-permeable membrane.
Which of the following options is correct?
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

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176. Identify the correct statement regarding plant excretion:
(A) Plants use an extensive network of specialized excretory tubes.
(B) Plants cannot excrete gaseous wastes.
(C) Plants excrete primarily urea.
(D) Plants can store wastes in leaves that fall off.

177. The urea cycle was discovered by which famous biochemists?
(A) Krebs and Henseleit
(B) James Watson and Francis Crick
(C) French scientist Louis Pasteur
(D) English scientist Robert Hooke

178. What happens to the rate of ADH secretion when a person drinks a large quantity of water?
(A) It increases.
(B) It remains constant.
(C) It decreases.
(D) It fluctuates rapidly.

179. A failure of the urinary sphincters to maintain control over urination results in:

(A) Incontinence
(B) Systemic uremia
(C) Renal glycosuria
(D) Acute nephritis

180. The process by which the kidney removes substances like penicillin or excess hydrogen ions directly from the blood into the nephron is:
(A) Glomerular ultrafiltration
(B) Passive osmosis
(C) Peritoneal dialysis
(D) Active secretion

181. Why are UTIs generally more common in human females than males?
(A) Because human females possess significantly larger functional kidneys.
(B) Female urethra is shorter and near the anus.
(C) Because female metabolic processes do not produce nitrogenous urea.
(D) Because females possess a anatomically larger urinary bladder organ.

182. A major preventative measure against kidney stones is a diet low in:
(A) Daily intake of water
(B) Refined dietary carbohydrates
(C) Dietary sodium and oxalate
(D) Fresh natural organic fruits

183. Identify the odd one out concerning waste elimination in humans:
(A) Urea
(B) Uric acid
(C) Carbon dioxide
(D) Sputum

184. The most concentrated urine is usually the one passed:
(A) First thing in the morning
(B) After drinking two litres of water
(C) Immediately after a large meal
(D) Before sleeping at night

185. Match the processes in List I with their locations in List II.
List I: Processes
P. Ultrafiltration
Q. Selective Reabsorption
R. Storage of urine
S. Transport to bladder
List II: Locations
1. Renal tubule
2. Ureter
3. Glomerulus
4. Urinary bladder
(A) P-1, Q-3, R-2, S-4
(B) P-3, Q-1, R-4, S-2
(C) P-4, Q-2, R-1, S-3
(D) P-3, Q-4, R-1, S-2

186. During winter, people tend to urinate more frequently than in summer. The primary biological reason for this is:
(A) Human kidneys physically expand and increase filtration capacity in cold weather.
(B) Reduced sweating increases urine volume to maintain water balance.
(C) The muscular urinary bladder significantly shrinks in capacity in cold weather.
(D) Pituitary ADH hormone production completely stops operating during winter months.

187. Which component of the blood carries urea from the liver to the kidneys?
(A) Blood plasma
(B) Red blood cells
(C) White blood cells
(D) Platelets

188. Which structure represents the central role of the kidney in continuous blood purification?
(A) The large anatomical size of the central renal pelvis
(B) The thick muscular layer present in the walls of the ureter
(C) Millions of nephrons filtering blood
(D) The presence of a tough protective outer renal capsule

189. A common plant waste, tannin, is economically useful to humans in which industry?
(A) Paper manufacturing
(B) Steel production
(C) Glass making
(D) Leather tanning

190. Rubber is obtained from the latex of the rubber tree. Latex is essentially:
(A) The primary vital water source for plant survival
(B) The main photosynthetic food source stored by plants
(C) A plant waste or secretory product
(D) The essential reproductive fluid of flowering plants

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191. In an artificial kidney, the dialysing fluid flows in the opposite direction to the patient's blood. This helps in:
(A) Efficiently cooling the warm blood down before returning to vessels
(B) Maintaining a steep concentration gradient for diffusion
(C) Safely pumping purified blood back into the systemic circulation
(D) Continuously adding fresh atmospheric oxygen into the flowing blood

192. Which excretory structure is correctly paired with the organism?
(A) Earthworm - Kidneys
(B) Fish - Malpighian tubules
(C) Cockroach - Nephridia
(D) Human - Nephrons

193. The primary reason we need to excrete urea is because it:
(A) It becomes toxic in the blood
(B) It significantly lowers core body temperature
(C) It causes rapid, unexplained body weight gain
(D) It directly interferes with gastrointestinal digestion

194. If the reabsorption of water in the kidneys fails entirely, a person would:
(A) Experience rapid excessive weight gain
(B) Completely stop producing liquid urine
(C) Become severely dehydrated
(D) Only excrete dry solid waste matter

195. Consider the following statements about kidney stones:
I. They are hard deposits of minerals and acid salts.
II. They can cause severe pain when blocking the ureter.
III. They are caused by drinking too much water.
Which of the above statement(s) is/are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II, and III

196. The main artery that branches off from the aorta to supply oxygenated blood to the kidney is the:
(A) Hepatic artery
(B) Pulmonary artery
(C) Mesenteric artery
(D) Renal artery

197. Some plants excrete excess salts directly through specialized glands. This is mostly seen in:
(A) Desert cacti plants
(B) Mangroves (halophytes)
(C) Domestic apple trees
(D) Agricultural wheat crops

198. Read the following statements about excretion in humans:
I. Kidneys filter blood to produce urine.
II. Ureters carry urine to the urinary bladder.
III. The urinary bladder stores urine temporarily.
IV. The urethra transports urine from the kidneys to the bladder.
Which of the above statement(s) is/are correct?
(A) II, III, and IV
(B) I, III, and IV
(C) I, II, and III
(D) I, II, III, and IV

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199. What is the most appropriate initial treatment for a mild urinary tract infection (UTI)?
(A) Undergoing an immediate surgical kidney transplant
(B) Long-term continuous hemodialysis therapy sessions
(C) Completely stopping all daily water consumption
(D) Antibiotics and increased fluid intake

200. Ultimately, maintaining a healthy excretory system requires a balance of:
(A) Hydration, balanced diet, and hygiene
(B) Consistently high protein intake combined with low water intake
(C) Strictly avoiding all dietary salts and refined sugars completely
(D) Routinely taking prescribed diuretic medicines on a daily basis

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ANSWERS

1. (A) Excretion
Biological activities generate various harmful metabolic waste products within living organisms. Excretion is the essential physiological process that systematically removes these toxic cellular wastes from the body. Eliminating unwanted by-products maintains internal chemical equilibrium and prevents toxicity. This vital mechanism ensures proper physiological function, cellular stability, and long-term survival across diverse living species.

2. (C) Urea
Metabolic waste products originate from cellular chemical processes inside living tissues. During the breakdown of excess proteins and amino acids, nitrogenous by-products are generated. Urea is a major nitrogenous waste compound produced in the liver and eliminated through the human excretory system. Undigested food remains unabsorbed digestive debris rather than a metabolic waste.

3. (A) Excretion removes metabolic wastes, whereas defecation removes undigested food.
Excretion and defecation differ fundamentally in their physiological origins and cellular pathways. Excretion eliminates nitrogenous metabolic wastes produced by cellular activities throughout the body, such as urea filtered by kidneys. Conversely, defecation is the digestive elimination of unabsorbed, undigested food materials through the alimentary canal. These distinct processes serve completely separate bodily biological functions.

4. (D) Ammonotelic
Nitrogenous waste elimination varies significantly among animal species based on water availability and metabolic adaptation. Organisms that primarily excrete nitrogenous waste in the form of highly toxic ammonia are classified as ammonotelic. Because ammonia requires substantial amounts of water for safe dissolution and rapid diffusion, this excretory mode predominates among aquatic species.

5. (B) Birds and reptiles
Uricotelic organisms excrete nitrogenous waste primarily as uric acid, a non-toxic compound that requires minimal water for elimination. Birds and reptiles are classic uricotelic species because converting nitrogenous waste into insoluble paste conserves vital body moisture. This specialized adaptation enables survival in dry terrestrial environments where water availability is restricted or highly variable.

6. (C) Urea
Human metabolism processes dietary and structural proteins, generating toxic ammonia as an intermediate metabolic waste product. The human liver rapidly converts this harmful ammonia into urea, which is far less toxic and moderately soluble in water. Urea travels through the bloodstream to the kidneys, where it becomes the principal nitrogenous waste excreted in urine.

7. (D) Aquatic bony fishes
Ammonia is extremely toxic and requires substantial quantities of water to safely dilute and excrete from animal tissues. Aquatic bony fishes continuously excrete ammonia across their gill membranes into the surrounding aquatic environment. Abundant environmental water allows these aquatic animals to dispose of toxic gaseous ammonia efficiently without suffering cellular damage or dehydration.

8. (A) Kidney
The kidney acts as the primary filtration organ in the human excretory system. Blood circulating through renal blood vessels enters functional nephron units, where metabolic nitrogenous wastes, excess water, and dissolved salts are systematically removed. This intricate biological filtration produces urine, continuously regulating fluid composition, osmotic pressure, and internal chemical balance throughout the human body.

9. (B) In the abdominal cavity, beside the backbone
Human kidneys are paired, bean-shaped excretory organs strategically positioned against the posterior abdominal wall. Located on either side of the vertebral column, they extend roughly

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between the last thoracic and third lumbar vertebrae. This abdominal position provides structural protection from retroperitoneal tissues and surrounding rib structures while facilitating direct access to major circulatory vessels.

10. (B) Kidney, Ureter, Urinary bladder, Urethra
Liquid waste moves through a well-defined sequence of excretory organs in the human body. Filtration occurs inside the kidneys to generate urine, which then travels down thin muscular channels called ureters. Urine accumulates inside the expandable urinary bladder for temporary storage before being discharged externally through the tubular canal designated as the urethra.

11. (A) Ureter
Each human kidney connects to the urinary storage organ via a narrow, muscular tube termed the ureter. Smooth muscle contractions within the walls of ureters generate peristaltic waves that actively propel collected urine downward. This directional transport continuously conveys processed fluid from the central renal pelvis into the urinary bladder for temporary storage.

12. (C) Urinary bladder
The urinary bladder is a hollow, distensible organ composed of specialized smooth muscle tissue. Positioned in the lower pelvic cavity, it receives urine continuously produced by both kidneys via the ureters. The elastic walls expand to accommodate increasing liquid volumes, temporarily holding stored urine until neural signals initiate the voluntary micturition process.

13. (D) Urethra
The final conduit of the human urinary tract is the urethra, a tubular passage extending from the neck of the urinary bladder to the body exterior. Controlled by voluntary and involuntary sphincter muscles, the urethra opens during micturition, allowing stored urine to be efficiently discharged from the body into the environment.

14. (C) Cortex
Cross-sectional examination of a human kidney reveals distinct structural regions. The outer peripheral layer extending beneath the protective fibrous capsule is designated as the renal cortex. This outer zone contains glomeruli, Bowman's capsules, and convoluted tubules, serving as the primary site for blood filtration and initial tubular reabsorption within the nephrons.

15. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
The human urinary bladder features walls made of smooth detrusor muscle richly innervated by the autonomic and somatic nervous systems. Voluntary control over the external urethral sphincter allows individuals to conscious regulate or suppress the urge to urinate. Nervous control over this muscular reservoir explains why micturition can be postponed until appropriate times.

16. (D) Renal medulla
The internal architecture of the human kidney is organized into outer and inner regions. Beneath the superficial cortex lies the renal medulla, which is divided into multiple cone-shaped tissue masses called renal pyramids. These medullary pyramids contain long loops of Henle and collecting ducts that transport urine toward the central renal pelvis.

17. (A) Renal pelvis
Deep within the medial concavity of the kidney lies a wide, funnel-shaped cavity called the renal pelvis. Major and minor renal calyces collect urine emptying from the medullary collecting ducts and drain it directly into this central basin. The renal pelvis then narrows continuously to join the ureter, directing fluid downward.

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18. (C) Nephron
Each human kidney contains approximately one million microscopic structural units known as nephrons. A nephron represents the essential functional unit responsible for filtering blood, removing metabolic wastes, and regulating fluid balance. Comprising a renal corpuscle and a tubular system, nephrons independently perform ultrafiltration, reabsorption, and tubular secretion to produce finished urine.

19. (A) Bowman's capsule
The initial segment of a nephron consists of a blind, cup-like epithelial sac called Bowman's capsule. Located in the renal cortex, this double-walled structure closely encloses the capillary network known as the glomerulus. Bowman's capsule collects the fluid filtrate forced out of glomerular capillaries during the process of high-pressure blood ultrafiltration.

20. (A) 2, 3, 1
Urine formation in human nephrons follows a strictly regulated sequential pathway. Blood undergoes high-pressure glomerular filtration first, forcing water and solutes into Bowman's capsule. Essential nutrients and water are subsequently reabsorbed along the tubular segments back into blood. Finally, tubular secretion actively transfers additional waste substances directly into the tubular lumen.

21. (B) Glomerulus
Blood entering the renal corpuscle branches into a intricate tuft of high-pressure capillaries termed the glomerulus. Supplied by the wider afferent arteriole and drained by the narrower efferent arteriole, this dense vascular bed is surrounded by Bowman's capsule. Glomerular capillary pressure drives the initial filtration of liquid plasma during urine formation.

22. (C) Glomerulus and Bowman's capsule
Ultrafiltration is the initial step of urine formation occurring at the renal corpuscle, which consists of the glomerulus and Bowman's capsule. Hydrostatic pressure forces water, small solutes, and nitrogenous wastes through the capillary walls and filtration slits. This non-selective pressure filtration yields a protein-free fluid filtrate inside the cup-shaped capsule.

23. (D) Renal tubule
As glomerular filtrate flows along the continuous renal tubule, essential biological substances are selectively reclaimed. The specialized epithelial cells lining the tubule reabsorb vital nutrients including glucose, amino acids, sodium ions, and bulk water back into peritubular capillaries. This intensive reabsorption prevents valuable metabolites from being lost in excreted urine.

24. (A) Red blood cells
Ultrafiltration in the renal corpuscle operates primarily as a mechanical size-exclusion process. Endothelial fenestrations, basement membranes, and podocyte filtration slits restrict the passage of large formed elements and macromolecules. Red blood cells are far too large to traverse this intact filtration barrier, remaining entirely inside glomerular capillaries under healthy physiological conditions.

25. (B) P-4, Q-1, R-3, S-2
Different organisms exhibit specific excretory and regulatory strategies suited to their habitats. Ammonotelic bony fishes excrete ammonia directly into water. Ureotelic human beings excrete nitrogenous waste primarily as urea. Uricotelic birds and reptiles convert waste into insoluble uric acid. Osmoregulation maintains appropriate water balance and mineral salt concentrations across all living organisms.

26. (B) Secretion
Tubular secretion is an active transport mechanism operating along renal tubules during urine formation. Epithelial cells selectively transfer extra metabolic wastes, potassium ions, hydrogen ions, synthetic drugs, and toxins directly from peritubular blood into the tubular fluid. This active step assists in fine-tuning blood pH, electrolyte concentrations, and total waste elimination.

27. (C) 95%
Normal human urine consists predominantly of water, serving as a liquid solvent for excreted organic and inorganic solutes. Water accounts for approximately ninety-five percent of total urine volume under standard physiological hydration states. The remaining five percent comprises dissolved nitrogenous wastes like urea, uric acid, creatinine, and various mineral salts.

28. (C) Urea
Normal human urine is an aqueous solution containing organic metabolic by-products and inorganic ions. Excluding water, urea represents the single most abundant solid solute dissolved in urine. Formed in the liver during amino acid deamination, urea constitutes roughly half of all dissolved solid material excreted daily through the urinary system.

29. (D) Glucose
Under normal conditions, virtually all glucose filtered into the nephron is completely reabsorbed in the proximal convoluted tubule. When blood glucose concentrations exceed the renal threshold, tubular reabsorption capacity becomes overwhelmed. Consequently, unabsorbed glucose appears in urine, a condition known as glycosuria, which serves as a clinical indicator of diabetes mellitus.

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30. (C) Hemodialysis
When human kidneys suffer severe operational failure, metabolic nitrogenous wastes and excess fluid rapidly build up in blood. Hemodialysis is a medical procedure that artificially filters and cleans blood outside the body. Circulating blood passes through semi-permeable dialyzing membranes, removing accumulated urea, creatinine, and excess electrolytes to maintain metabolic stability.

31. (B) Dialysis machine
A dialysis machine functions as an artificial kidney for patients experiencing end-stage renal disease or acute kidney failure. The apparatus channels blood through specialized semi-permeable cellulose tubing surrounded by dialyzing fluid. Through controlled diffusion across concentration gradients, the machine effectively removes toxic metabolic wastes and regulates systemic electrolyte levels in blood.

32. (D) Selective reabsorption
Artificial kidney machines perform filtration of nitrogenous wastes and regulate fluid levels through passive diffusion across semi-permeable membranes. However, dialysis equipment lacks specialized tubular epithelial cells and active transport mechanisms present in biological nephrons. Consequently, artificial dialysis cannot perform selective reabsorption of vital nutrients like glucose and amino acids into blood.

33. (A) Nitrogenous wastes
Dialysing fluid utilized during hemodialysis is formulated with an electrolyte and solute composition nearly identical to normal blood plasma. However, dialysing fluid intentionally contains zero nitrogenous wastes such as urea and uric acid. This steep concentration gradient facilitates the rapid outward diffusion of accumulated metabolic wastes from blood into dialysate solution.

34. (C) Kidney transplantation
End-stage renal failure occurs when both kidneys permanently lose their capacity to filter waste and maintain fluid homeostasis. While hemodialysis provides temporary life support, kidney transplantation represents the definitive long-term medical treatment. Surgical implantation of a functioning donor kidney restores native biological filtration, hormone production, and overall metabolic regulation.

35. (A) I and II
Kidney transplantation involves surgically grafting a healthy donor organ into a recipient suffering from permanent renal failure. Sourcing donor organs from close living relatives increases tissue compatibility, significantly reducing immunological graft rejection risks. Non-functioning native kidneys are typically left in place unless they cause persistent infections or severe hypertension.

36. (D) Skin
Human skin acts as an accessory excretory structure through specialized sudoriferous or sweat glands distributed across the integumentary surface. As sweat glands secrete watery sweat to cool the body, small amounts of metabolic wastes including urea, sodium chloride, and lactic acid are simultaneously eliminated. This secondary excretion supports thermal and osmotic balance.

37. (B) Traces of water and salts
The primary physiological role of human sweat glands is evaporative cooling during thermal stress. Nevertheless, sweat fluid naturally contains dissolved excretory compounds, including abundant water, sodium chloride, and minute traces of urea. Evaporating sweat dissipates heat while simultaneously discharging small quantities of metabolic salts and fluid through epidermal skin pores.

38. (C) Carbon dioxide
Cellular respiration inside body tissues continuously consumes oxygen and generates carbon dioxide as a gaseous metabolic waste product. Blood transports dissolved carbon dioxide to pulmonary capillaries surrounding pulmonary alveoli. The lungs eliminate this gaseous waste through passive diffusion across alveolar membranes, expelling carbon dioxide from the body during normal expiration.

39. (D) Water vapour
Human lungs function primarily in gas exchange but simultaneously serve an important accessory excretory role. As respiratory air passes over moist mucous membranes lining respiratory passages, water evaporates into the expired gas stream. Consequently, lungs continuously eliminate carbon dioxide waste along with significant amounts of water vapor during normal breathing cycles.

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40. (A) Liver
Protein catabolism produces toxic ammonia within tissues, which poses severe cellular health risks if allowed to accumulate. The human liver contains specialized enzyme systems that rapidly process this toxic compound. Through biochemical reactions, liver cells convert highly dangerous ammonia into significantly less toxic urea, which enters circulation for eventual kidney elimination.

41. (B) Urea cycle
The liver utilizes a specialized metabolic pathway known as the urea cycle, or ornithine cycle, to neutralize toxic nitrogenous by-products. This biochemical cascade combines ammonia with carbon dioxide through sequential enzymatic reactions. The resulting compound, urea, is released into hepatic veins and safely transported to kidneys for excretion in urine.

42. (B) Liver
Aged and worn red blood cells are continuously broken down inside the reticuloendothelial system, releasing hemoglobin components. The liver processes the heme moiety into excretory bile pigments, primarily bilirubin and biliverdin. These pigments are secreted into bile, entering the digestive tract for eventual discharge from the body through fecal elimination.

43. (A) Stomata and lenticels
Botanical gaseous exchange occurs directly through specialized microscopic openings in plant tissues. Microscopic stomata located on leaves facilitate daytime oxygen release from photosynthesis and nighttime carbon dioxide output from respiration. Additionally, lenticels present in woody stem bark allow continuous gaseous diffusion, effectively releasing metabolic gas by-products into surrounding air.

44. (C) Old leaves
Plants lack centralized excretory organs, utilizing structural shedding as an alternative waste management strategy. Metabolic by-products and mineral salts accumulate over time within cellular vacuoles of mature foliage. When leaves age and senesce, plants discard these old leaves through abscission, permanently removing accumulated internal wastes from the organism.

45. (D) I, II, and III
Plant excretion relies on distinct non-specialized biological mechanisms. Lacking complex excretory organ systems, plants release excess water vapor via foliar transpiration and store metabolic by-products within cellular vacuoles or senescent tissues. Nitrogenous wastes like urea are absent because plants recycle amino compounds efficiently rather than producing toxic nitrogenous excretion.

46. (C) Old xylem
Plants synthesize complex organic waste by-products, including gums, resins, and latex, during secondary metabolic pathways. These thick organic excretions are progressively deposited and safely isolated within non-functional vascular tissues, particularly old xylem vessels inside central heartwood. Storing metabolic wastes in inactive xylem prevents interference with active transport systems.

47. (B) Stored plant waste products
Tannins represent complex polyphenolic secondary metabolites synthesized by various tree species. Deposited predominantly within outer bark tissues, heartwood, and protective seed coats, tannins function as stored organic plant wastes. Their bitter astringent properties simultaneously deter herbivorous animals and protect vulnerable plant structures against fungal or bacterial microbial infections.

48. (D) True for some plants
Excretory strategies among plant species extend beyond cellular storage and foliar shedding. Certain terrestrial and aquatic plant species actively exudate organic acids, excess mineral salts, and metabolic waste compounds directly through root membranes into surrounding soil. This specialized root excretion modifies rhizosphere chemistry and helps regulate internal ion levels.

49. (A) Ammonia is soluble in water and diffuses across gills.
Aquatic species like bony fishes excrete nitrogenous waste primarily as gaseous ammonia. Ammonia exhibits exceptionally high water solubility and readily diffuses down concentration gradients. Consequently, fish excrete ammonia passively across thin gill membranes directly into surrounding environmental water, eliminating

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the need to synthesize complex, energy-expensive non-toxic excretory compounds.

50. (C) Renal artery → Glomerulus → Renal vein
Blood flow through human kidneys follows a precise anatomical vascular route. Waste-laden arterial blood enters the kidney through the renal artery, branching into afferent arterioles that supply glomerular capillaries. Following ultrafiltration within the glomerulus, purified blood exits through efferent arterioles and peritubular networks, eventually collecting into the renal vein.

51. (A) Kidney stones
Kidney stones, scientifically termed renal calculi, represent solid crystalline aggregates that form within the urinary tract. Unbalanced urinary pH, low urine volume, and elevated solute concentrations promote mineral precipitation. These hard mineral deposits collect in renal calyces or ureters, causing severe localized pain and potential urinary drainage obstruction.

52. (D) Calcium oxalate
Chemical analysis of urinary calculi demonstrates that calcium salts form the primary constituent of most kidney stones. Specifically, calcium oxalate crystals account for the majority of diagnosed renal stones. High dietary oxalate levels, dehydration, and elevated urinary calcium promote crystal nucleation and aggregation within renal tubule structures.

53. (B) Urinary Tract Infection
The acronym UTI represents Urinary Tract Infection, a medical condition caused by microbial proliferation within urinary system components. Pathogenic bacteria typically colonize the urethra, ascending toward the urinary bladder or kidneys. Common symptoms include dysuria, urinary frequency, and abdominal discomfort, requiring prompt antibiotic treatment to prevent kidney injury.

54. (C) Osmoregulation
In addition to filtering nitrogenous metabolic wastes from blood, kidneys perform the crucial function of osmoregulation. By regulating the reabsorption or excretion of water and mineral electrolytes like sodium and potassium, kidneys maintain constant blood osmotic pressure, systemic fluid volume, and homeostatic electrolyte balance throughout human internal tissues.

55. (D) Assertion (A) is false but Reason (R) is true.
During warm summer months, elevated temperatures stimulate profuse sweating to facilitate thermoregulation and bodily cooling. Significant cutaneous fluid loss reduces total blood volume and triggers antidiuretic hormone release. Consequently, kidneys increase water reabsorption, producing smaller volumes of concentrated urine. Therefore, urine output decreases during summer compared to winter.

56. (A) Osmoregulation
Osmoregulation is the physiological process by which organisms actively regulate internal osmotic pressure and fluid balance. By controlling concentrations of water, dissolved salts, and inorganic ions in body fluids, osmoregulation prevents excessive cellular swelling or shrinkage. This mechanism maintains homeostatic stability in blood, interstitial fluid, and intracellular environments.

57. (B) Circulatory system
The excretory system relies entirely on the circulatory system for metabolic transport. Blood flowing through vascular networks collects metabolic waste products generated by active body cells throughout peripheral tissues. Circulating plasma continuously delivers these nitrogenous wastes, excess water, and dissolved solutes directly into renal arteries for kidney filtration.

58. (B) Antidiuretic hormone
Antidiuretic hormone, also known as vasopressin, is synthesized in the hypothalamus and released by the posterior pituitary gland. ADH targets distal convoluted tubules and collecting ducts in nephrons, increasing water permeability. This hormonal mechanism enhances water reabsorption into blood, concentrating urine and preventing excessive fluid loss during dehydration.

59. (A) Increase
Elevated blood levels of antidiuretic hormone signal nephron collecting ducts to insert additional aquaporin water channels into tubular cell membranes. This structural change significantly increases water permeability across renal tubules. Consequently, the rate of water

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reabsorption back into surrounding blood vessels increases, producing highly concentrated urine of low volume.

60. (A) 2, 1, 4, 3
Nitrogen waste disposal follows a systematic physiological pathway. Highly toxic ammonia is first converted into urea within liver cells. Newly synthesized urea enters systemic circulation via hepatic veins for transport. Kidneys filter this circulating urea out of blood plasma, directing the collected fluid through urinary structures for eventual elimination.

61. (D) Kidney disorders or diabetes
Routine urinalysis is a key diagnostic procedure that evaluates physical and chemical properties of urine. Detecting abnormal constituents such as glucose, proteins, red blood cells, or ketone bodies reveals underlying metabolic and renal pathologies. Consequently, urine testing effectively identifies diabetes mellitus, glomerulonephritis, urinary infections, and impaired renal function.

62. (C) Glomerulus
The intact glomerular filtration membrane prevents plasma proteins like albumin from crossing into Bowman's capsule due to size and charge barriers. The presence of excess protein in urine, termed proteinuria, indicates structural damage to glomerular capillaries. Inflamed or leaky glomeruli allow large proteins to pass freely into tubular fluid.

63. (B) Kidney stones
Adequate daily fluid intake maintains high urine flow rates and dilute solute concentrations within the urinary tract. Consuming sufficient water prevents mineral salts like calcium, oxalate, and uric acid from reaching supersaturation levels. Consequently, proper hydration effectively prevents crystal nucleation, aggregation, and subsequent formation of painful kidney stones.

64. (B) 10-12 cm
The human kidney is a reddish-brown, bean-shaped organ located in the posterior abdominal wall. In average healthy adults, an individual kidney measures approximately ten to twelve centimeters in length, five to seven centimeters in width, and two to three centimeters in thickness, weighing roughly one hundred twenty to one hundred seventy grams.

65. (A) P-4, Q-1, R-3, S-2
Plants utilize distinct processes for managing gaseous, liquid, and solid waste products. Oxygen is produced as a gaseous by-product during photosynthetic reactions. Resins are complex excretory products stored inside old xylem tissues. Dead leaves are shed periodically to eliminate accumulated metabolic wastes. Transpiration continuously releases excess absorbed water vapor.

66. (C) Urochrome
Normal human urine exhibits a characteristic pale yellow coloration due to the pigment urochrome, also termed urobilin. Urochrome is a natural metabolic breakdown product resulting from the normal catabolism of heme in degraded hemoglobin molecules. The concentration of urochrome determines whether urine appears light yellow or dark amber.

67. (A) Liver
Anatomical positioning of human kidneys demonstrates asymmetrical placement within the abdominal cavity. The large, bulky right lobe of the liver occupies substantial space in the upper right quadrant beneath the diaphragm. Consequently, the right kidney is pushed slightly downward, positioning it lower relative to the left kidney.

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68. (D) It transports metabolic wastes from body cells to the kidneys.
The circulatory system serves as the primary transport network connecting peripheral metabolic tissues with renal filtration organs. Vascular capillaries collect metabolic waste products like urea and creatinine from metabolizing body cells. Systemic blood flow carries these wastes through renal arteries directly into kidneys, enabling continuous filtration and waste removal.

69. (B) Urea formation - Kidney
Urea formation and kidney function represent distinct biological processes. Highly toxic ammonia generated by amino acid breakdown is converted into urea exclusively inside liver cells via the urea cycle. Kidneys do not synthesize urea; rather, they filter pre-formed urea out of circulating blood to produce excreted urine.

70. (C) Heart
The excretory system includes specialized organs that directly or secondarily remove waste products from the body. Kidneys filter nitrogenous fluid wastes, the liver converts toxic ammonia and forms bile pigments, and skin excretes sweat salts. Conversely, the heart is a muscular pump of the circulatory system without waste-eliminating functions.

71. (D) They produce bile pigments.
Human kidneys are bean-shaped abdominal organs containing millions of nephrons that filter blood and form urine. However, bile pigments such as bilirubin and biliverdin are produced exclusively by the liver during hemoglobin degradation. Kidneys do not synthesize bile pigments; these substances pass through bile into the intestinal tract.

72. (A) Heparin
During hemodialysis, blood is diverted out of the body through mechanical tubing inside a dialyzer machine. Contact with artificial foreign surfaces triggers rapid blood coagulation pathways. To prevent clotting within dialysis lines, an anticoagulant compound such as heparin is added to blood before it flows through dialyzing membranes.

73. (B) It takes deoxygenated, filtered blood away from the kidney.
The renal vein plays a critical role in renal vascular circulation. Blood entering the kidney via the renal artery undergoes nephron filtration to remove urea and excess solutes. Purified, deoxygenated blood gathers into peritubular venules and exits the kidney through the renal vein, returning directly into the inferior vena cava.

74. (B) Movement of wastes from blood into the renal tubule
Tubular secretion is an essential step in urine formation occurring along renal nephron tubules. Specialized tubular epithelial cells actively transport excess hydrogen ions, potassium ions, creatinine, and metabolic drug residues from surrounding peritubular capillary blood directly into tubular fluid. This active mechanism aids in fine-tuning blood pH and removing residual wastes.

75. (A) I, II, and III
Osmoregulation is a critical homeostatic mechanism that maintains precise salt and water equilibrium throughout human body fluids. Human kidneys serve as the principal osmoregulatory organs, adjusting water excretion and ion reabsorption to keep blood solute concentrations stable. This integrated control prevents destructive osmotic shifts across vascular and cellular membranes.

76. (C) Nephridia
Earthworms possess specialized tubular excretory organs called nephridia distributed segmentally throughout their bodies. Uncurving ciliated funnels collect coelomic fluid containing metabolic wastes. As fluid passes along coiled nephridial tubules, essential solutes and water are reabsorbed, while nitrogenous wastes like urea and ammonia are excreted externally through nephridiopores.

77. (D) Malpighian tubules
Terrestrial insects such as cockroaches utilize thin, blind-ending filamentous structures known as Malpighian tubules for excretion. Suspended within hemolymph, these tubules absorb nitrogenous wastes, water, and mineral salts. Wastes are converted into uric acid and funneled into the digestive tract, allowing maximal water reabsorption before solid waste elimination.

78. (C) Cystitis
Cystitis is an inflammatory condition affecting the mucous lining of the human urinary bladder, usually caused by bacterial infection. Escherichia coli ascending through the urethra commonly triggers bladder inflammation. Typical clinical symptoms include severe pelvic discomfort, persistent painful urination, dysuria, and increased urinary urgency requiring targeted antimicrobial treatment.

79. (B) Uremia
Uremia is a grave clinical syndrome resulting from severe acute or chronic kidney failure. When nephron filtration capacity declines significantly, nitrogenous waste products like urea, uric acid, and creatinine accumulate rapidly within blood circulation. Elevated systemic concentrations of toxic metabolic by-products disrupt cellular homeostasis and require immediate dialysis or transplantation.

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80. (D) It prevents toxic waste accumulation.
Cellular metabolic processes continuously produce nitrogenous waste compounds, acid by-products, and toxic substances. Without effective elimination, accumulating metabolic wastes alter cellular pH, disrupt osmotic gradients, and poison enzymatic machinery. Excretion is vital because continuous removal of toxic wastes maintains internal chemical equilibrium and protects body tissues from metabolic toxicity.

81. (A) Loop of Henle
The tubular portion of a nephron includes a distinctive hairpin-shaped hairpin bend termed the loop of Henle. Located predominantly within the renal medulla, it consists of a thin descending limb and a thick ascending limb. This U-shaped loop creates a medullary osmotic gradient essential for concentrating urine and conserving water.

82. (C) Drinking sufficient water daily
Maintaining high fluid intake is the most effective preventative strategy against renal calculus formation. Ample daily water consumption increases overall urine volume, significantly diluting stone-forming mineral ions such as calcium, oxalate, and uric acid. Dilute urinary fluid prevents crystal nucleation and aggregation, allowing minerals to pass harmlessly through the tract.

83. (A) Diffusion
Aquatic plants absorb nutrients directly from surrounding water and lack complex internal excretory organ systems. Simple metabolic waste products, such as dissolved gases and small water-soluble molecules, move passively down concentration gradients across cell membranes. Simple diffusion into surrounding aquatic environments allows aquatic plants to eliminate cellular wastes efficiently.

84. (D) Nitrogenous wastes
Protein catabolism involves deamination of excess amino acids, releasing amine groups that yield toxic ammonia. In metabolic tissues, these amine residues are converted into various nitrogenous wastes, including urea and uric acid. Unlike carbohydrate and lipid metabolism which yields carbon dioxide and water, protein breakdown uniquely generates nitrogenous waste.

85. (B) I, II, and III
The liver performs vital excretory precursor functions by deaminating excess amino acids, converting dangerous ammonia into urea, and forming bile pigments from degraded red blood cell hemoglobin. However, blood filtration and urine formation occur exclusively in kidneys. The liver does not filter urea out of blood to produce urine.

86. (C) Renal artery
Oxygenated blood laden with metabolic nitrogenous wastes enters each kidney through the renal artery, which branches directly from the abdominal aorta. This high-pressure arterial vessel delivers waste-filled blood to renal arterioles and glomerular capillary networks, supplying the essential volume needed for continuous renal filtration and nephron metabolism.

87. (D) Antidiuretic hormone
Antidiuretic hormone regulates water conservation by increasing water reabsorption in renal collecting ducts. A deficiency or absence of ADH reduces nephron membrane permeability to water. Consequently, renal tubules fail to reabsorb water back into blood, causing the continuous excretion of large volumes of dilute urine, a condition termed diabetes insipidus.

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88. (A) Faeces
Defecation is the physiological process of expelling unabsorbed food residue from the gastrointestinal tract. Indigestible dietary fiber, gut bacteria, mucus, and bile pigments gather in the large intestine to form semi-solid faeces. Unlike liquid urine from metabolic excretion, faeces represents undigested alimentary waste eliminated through the anal canal.

89. (B) Hydathodes
Guttation is the exudation of liquid water drops from leaf margins under conditions of high soil moisture and low transpiration. This specialized process occurs through dedicated pore-like leaf structures termed hydathodes. Root pressure forces xylem sap upward, releasing excess water along with dissolved mineral salts through hydathode openings.

90. (B) Bowman's capsule → Proximal tubule → Loop of Henle → Distal tubule
Fluid filtered at the glomerulus flows through a precise sequence of nephron structures. The

filtrate collects inside Bowman's capsule before entering the proximal convoluted tubule for major reabsorption. Fluid then travels through the descending and ascending limbs of the loop of Henle, reaching the distal convoluted tubule before entering collecting ducts.

91. (C) Both (A) and (B)
The volume of water reabsorbed by nephron tubules is dynamically regulated according to physiological demands. Water reabsorption increases when systemic hydration levels are low or when high concentrations of dissolved nitrogenous wastes need to be excreted. These dual factors ensure effective osmoregulation while maintaining adequate waste elimination in urine.

92. (D) 180 litres
High glomerular capillary blood pressure drives continuous fluid filtration across renal corpuscles. In healthy adult humans, both kidneys process approximately one hundred twenty-five milliliters of filtrate per minute. Over twenty-four hours, this rapid filtration rate yields approximately one hundred eighty liters of initial glomerular filtrate entering nephron Bowman capsules.

93. (D) Most filtrate is reabsorbed by tubules.
Although human kidneys generate roughly one hundred eighty liters of initial glomerular filtrate daily, actual urine output averages only one to two liters. This massive reduction occurs because specialized epithelial cells along renal tubules selectively reabsorb over ninety-nine percent of filtered water and essential solutes back into peritubular capillaries.

94. (C) Homeostasis
Homeostasis is the fundamental physiological process by which living organisms maintain stable internal chemical and physical conditions. By continuously filtering blood, removing metabolic nitrogenous wastes, and adjusting water and electrolyte balances, kidneys ensure that systemic fluid composition remains within optimal limits necessary for cellular survival and cellular function.

95. (C) Assertion (A) is true but Reason (R) is false.
Dialysis apparatus acts as an artificial kidney, filtering toxic urea and excess solutes from patient blood when biological kidneys fail. However, dialysis provides supportive blood cleansing rather than a permanent cure. It cannot restore damaged nephron architecture or renal endocrine function, requiring patients to undergo lifetime therapy or transplantation.

96. (D) Urinary tract infections
Maintaining strict personal hygiene around external genital areas prevents pathogenic microorganisms from colonizing the urethral opening. Bacterial pathogens, particularly gastrointestinal species, can easily ascend through the urethra into the urinary bladder. Proper hygiene practices significantly reduce microbial entry, thereby preventing painful lower and upper urinary tract infections.

97. (A) Hematuria
Healthy glomerular capillaries restrict the filtration of intact cellular formed elements due to tight structural barriers. The presence of intact red blood cells in excreted urine is an abnormal clinical condition designated as hematuria. Hematuria indicates vascular injury, acute glomerular inflammation, trauma, or calculus lesions within urinary tract passages.

98. (C) Renal capsule
The outermost structural boundary enclosing each kidney is a tough, fibrous connective tissue envelope known as the renal capsule. Surrounding the renal cortex, this dense fibrous membrane protects delicate internal nephron structures from physical trauma, maintains renal organ shape, and provides a barrier against expanding localized infections.

99. (A) Two separate openings
Ureters are paired muscular tubes that convey urine generated by each kidney downward toward the urinary bladder. Anatomically, each ureter enters the posterior base of the urinary bladder independently through its own distinct orifice. These two separate openings, along with the urethral orifice, form the triangular trigone area inside the bladder.

100. (A) 2, 1, 3, 4
Carbon dioxide gas elimination follows a specific anatomical sequence from tissues to the atmosphere. Cellular respiration releases carbon dioxide into systemic blood circulation. Blood transports dissolved gas to pulmonary alveoli capillaries. Diffusing into alveolar air spaces, carbon dioxide ascends through the trachea

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before being expelled externally via the nasal passages.

101. (B) Frog
Ureotelic organisms excrete nitrogenous waste primarily as urea, a moderately toxic compound requiring moderate water for excretion. Adult frogs are classical ureotelic amphibians. While larval tadpoles excrete ammonia in aquatic environments, adult frogs transition during metamorphosis to ureotelism, excreting urea to conserve water during terrestrial life.

102. (C) Snake
Uricotelic organisms process nitrogenous wastes into uric acid, an insoluble compound excreted with minimal water loss. Reptiles like snakes are uricotelic, adapting to dry terrestrial habitats. Converting toxic metabolic ammonia into paste-like uric acid allows snakes to conserve vital body moisture while safely eliminating metabolic nitrogen waste.

103. (D) It conserves body water during waste excretion.
Excreting uric acid as a semi-solid white paste provides a crucial evolutionary advantage for birds and terrestrial reptiles. Uric acid is non-toxic and virtually insoluble in water, allowing it to precipitate out of solution. This characteristic enables complete water reabsorption in cloacal structures, conserving vital body fluid in dry environments.

104. (A) Urethral sphincter
Micturition is regulated by muscular rings called urethral sphincters located at the neck of the urinary bladder. The internal urethral sphincter operates involuntarily under autonomic control, while the external urethral sphincter consists of skeletal muscle under voluntary control. Coordinated relaxation of these sphincters permits stored urine discharge.

105. (B) P-2, Q-3, R-4, S-1
Human urinary system components execute specialized sequential roles. Glomerular capillary networks perform blood filtration to generate initial filtrate. Ureters transport collected urine from renal pelvises down to the lower abdomen. The expandable muscular urinary bladder provides temporary urine storage. Finally, the tubular urethra conveys urine outside the body.

106. (B) Vacuoles
Plant cells manage metabolic waste products without specialized excretory organs by utilizing membrane-bound organelles. Large central vacuoles inside plant cells store insoluble organic wastes, excess mineral ions, and secondary metabolites. Isolating metabolic wastes within vacuolar fluid prevents toxic interactions with cytoplasmic enzymes and essential organelles.

107. (A) Calcium oxalate
Plants often convert toxic metabolic by-products into insoluble crystalline deposits before leaf shedding. Calcium oxalate crystals accumulate extensively inside plant cell vacuoles and leaf tissues. Storing metabolic waste as solid calcium oxalate neutralizes oxalic acid toxicity, safely sequestering waste within foliage destined to fall off during seasonal abscission.

108. (C) Due to the liver on the right side
Structural asymmetry in human abdominal anatomy determines kidney position. The liver is a large, dense organ occupying most of the upper right abdominal cavity below the diaphragm. Its substantial volume displacement forces the right kidney slightly downward, resulting in the left kidney residing marginally higher in the retroperitoneal space.

109. (D) Glomerular capillary wall
Ultrafiltration in the renal corpuscle occurs across a specialized triple-layered filtration membrane. This barrier consists of fenestrated glomerular capillary endothelial cells, a dense basement membrane, and specialized podocyte epithelial cells with filtration slits. Hydrostatic blood pressure forces fluid and small solutes across this capillary wall into Bowman's capsule cavity.

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110. (C) Renal medulla
The internal structure of the human kidney is divided into cortical and medullary zones. The inner region, designated as the renal medulla, contains medullary pyramids. These cone-shaped structures house the hairpin loops of Henle and long collecting ducts, which run parallel to collect and concentrate urine before pelvic drainage.

111. (B) Renal cortex
Anatomical mapping of nephrons shows distinct zonal distribution within the kidney. The outer region, called the renal cortex, contains all

renal corpuscles, which comprise glomeruli and surrounding Bowman's capsules. Additionally, proximal and distal convoluted tubules reside within cortical tissue, making the cortex the primary site for initial ultrafiltration.

112. (D) Urea - Nitrogenous waste
Metabolic breakdown of excess amino acids produces nitrogenous compounds that require excretion. Urea represents the primary nitrogenous waste compound synthesized by human liver enzymes and excreted by kidneys in urine. Resins are plant wastes, dialysis treats kidney failure, and defecation removes undigested digestive residue rather than nitrogenous urea.

113. (A) Lower back and abdomen
Renal calculi lodging in the renal pelvis or ureter cause severe, sharp spasmodic pain known as renal colic. Pain typically originates in the flank or lower back region behind the ribs and radiates anteriorly toward the lower abdomen and groin. Muscle spasms trying to move the stone cause intense discomfort.

114. (C) Micturition
Micturition is the scientific term for the physiological process of expelling urine from the urinary bladder. Controlled by coordinated neural reflexes, micturition involves detrusor muscle contraction in the bladder wall combined with simultaneous relaxation of internal and external urethral sphincters, allowing stored urine to exit through the urethra.

115. (A) I and II
Urine production involves distinct physiological mechanisms along nephrons. Glomerular filtration operates non-selectively based on molecular size, filtering all small plasma solutes into Bowman's capsule. Conversely, tubular reabsorption is highly selective, using active transport to reclaim vital substances. Tubular secretion moves additional wastes from blood into filtrate, not into blood.

116. (D) Amino acids
Ammonia is a highly toxic nitrogenous by-product formed during the catabolism of dietary and cellular proteins. Specialized hepatic enzymes deaminate excess amino acids, stripping away nitrogen-containing amino groups. This metabolic reaction generates free ammonia, which the liver rapidly processes into less harmful urea to prevent systemic toxicity.

117. (B) Presence of albumin
Albumin is a major plasma protein normally retained in systemic circulation by intact glomerular filtration barriers. Healthy kidneys prevent albumin passage into nephron tubules. Finding albumin in urine, termed albuminuria, signifies damaged glomerular membranes or impaired renal tubule function, serving as a reliable clinical marker for kidney pathology.

118. (C) Afferent arteriole is wider than efferent arteriole.
Ultrafiltration in the glomerulus relies on sustained high hydrostatic blood pressure. This elevated pressure is structurally created because the incoming afferent arteriole possesses a significantly wider lumen diameter than the exiting efferent arteriole. Vascular resistance caused by the narrower outflow vessel forces fluid plasma out into Bowman's capsule cavity.

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119. (D) Renal pelvis
Urine generated in individual nephrons flows through distal convoluted tubules into linear collecting ducts. These collecting ducts descend through medullary pyramids, converging at renal papillae to discharge urine into minor and major calyces. Calyces pool the collected liquid waste directly into the funnel-shaped renal pelvis before ureteric transport.

120. (A) Drinking sufficient water daily
Consuming adequate water daily is fundamental for maintaining long-term kidney health and optimal excretory function. Ample fluid intake maintains high renal blood flow, prevents mineral solute supersaturation, reduces kidney stone formation risks, and facilitates efficient flushing of metabolic nitrogenous wastes through nephron tubules and lower urinary passages.

121. (B) Water and dissolved salts
Human sweat is an aqueous secretion produced by cutaneous sudoriferous glands across the skin surface. Composed primarily of over ninety-nine percent water, sweat contains dissolved mineral salts, predominantly sodium chloride. Minor metabolic wastes including urea and lactic acid are also present, aiding thermoregulation through evaporative skin cooling.

122. (B) Sudoriferous glands
Sweat glands distributed throughout human skin layers are scientifically designated as sudoriferous glands. These tubular exocrine glands secrete watery fluid onto the epidermal surface. Primary physiological functions include thermoregulatory evaporative cooling, along with secondary excretion of water, sodium chloride, and minute quantities of nitrogenous metabolic wastes.

123. (A) Blood volume and solutes remain constant
Excretion and osmoregulation operate concurrently to preserve internal homeostatic balance. While excretion systematically removes toxic nitrogenous metabolic wastes, osmoregulation precisely controls water retention and mineral solute concentrations. Together, these processes ensure that total circulating blood volume, plasma osmotic pressure, and intracellular electrolyte balance remain remarkably stable.

124. (C) Skin
While kidneys serve as primary filtration organs, human skin acts as an accessory excretory structure. Sudoriferous glands in dermal skin layers continuously produce sweat, which contains water, inorganic sodium chloride, and small quantities of urea. Excreting these dissolved wastes across the epidermis complements renal function and supports bodily thermoregulation.

125. (D) I, II, and III
Hemodialysis effectively removes nitrogenous urea and excess salts by passing blood through semi-permeable cellulose tubes bathed in waste-free dialysing fluid. Wastes diffuse down steep concentration gradients out of blood. However, dialysis relies purely on passive physical diffusion and lacks epithelial active transport mechanisms required for selective reabsorption of glucose.

126. (C) 2-3 times a week
Patients suffering from end-stage renal disease or severe chronic kidney failure require regular artificial blood cleansing to survive. Hemodialysis treatment is typically scheduled two to three times per week, with each clinical session lasting several hours. Regular therapy prevents lethal accumulation of toxic urea, potassium, and fluid volumes.

127. (B) Calcium oxalate crystals
Botanical excretory management frequently involves converting liquid metabolic by-products into inert solid forms. Plant cells synthesize oxalic acid, which combines with cellular calcium ions to form insoluble calcium oxalate crystals, known as raphides or druses. Deposited inside central vacuoles, these crystalline solids neutralize chemical toxicity without harming plant cells.

128. (D) Plant excretory products
Essential oils found in aromatic plants like eucalyptus, sandalwood, mint, and citrus are secondary metabolic by-products. Plants synthesize these complex volatile organic compounds during specialized metabolic pathways, storing them in glandular trichomes or secretory cavities. Functioning as plant excretory products, these oils simultaneously provide defensive antimicrobial and herbivore-deterrent properties.

129. (A) Simple diffusion across cell surface
Unicellular aquatic protozoans like Amoeba lack complex specialized excretory organ systems. Soluble metabolic waste products, particularly ammonia generated from cellular protein metabolism, dissolve directly into intracellular fluid. Because the organism possesses a high surface-area-to-volume ratio, ammonia freely diffuses across the thin plasma membrane into surrounding water.

130. (C) Osmoregulation
Freshwater protozoans like Amoeba continuously gain water from their hypotonic aquatic environment through osmosis. To prevent cell rupture, Amoeba utilizes a specialized organelle termed the contractile vacuole. This vacuole actively collects excess intracellular water, swells, moves to the cell membrane, and contracts to expel water externally, performing essential osmoregulation.

131. (A) From the liver
The liver is the sole organ responsible for executing the complete urea cycle in humans. Hepatic enzymes convert toxic ammonia into urea within hepatocytes. Once synthesized, urea is secreted directly into hepatic veins, entering systemic blood circulation. Blood plasma then transports this dissolved urea to kidneys for final renal filtration.

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132. (D) Ammonia from urea breakdown
Freshly excreted human urine contains dissolved urea and possesses minimal odor. However, environmental bacteria in public urinals produce urease enzymes that rapidly hydrolyze urea into volatile ammonia gas. The accumulation of released gaseous ammonia creates the strong, pungent odor characteristic of unhygienic or stagnant urinary facilities.

133. (B) It is a universal solvent
Water possesses unique dipolar chemical properties, allowing it to dissolve a wide variety of polar organic molecules and inorganic salts. As a universal biological solvent, water provides an ideal liquid medium for dissolving cellular metabolic waste products, facilitating easy transport through blood and efficient excretion in aqueous urine.

134. (C) Frog
Birds like pigeons and sparrows, along with reptiles like lizards, are strictly uricotelic organisms, excreting nitrogenous waste primarily as insoluble uric acid paste to conserve body water. In contrast, adult frogs are ureotelic amphibians that excrete soluble urea into moist environments, making frogs distinct among the listed terrestrial vertebrates.

135. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Aquatic bony fishes excrete nitrogenous waste primarily as toxic ammonia, classifying them as ammonotelic animals. Ammonia exhibits extreme water solubility and small molecular size, allowing it to rapidly diffuse down concentration gradients. Abundant surrounding water enables continuous, direct diffusion of gaseous ammonia across thin gill membranes into the environment.

136. (A) Valves between ureters and bladder
Ureters penetrate the muscular wall of the urinary bladder at an oblique angle, forming functional physiological flap valves. As the bladder fills and internal pressure rises, the detrusor muscle compresses the lower ureteric segments. This compression prevents the backward reflux of stored urine upward toward the kidneys, protecting delicate nephrons.

137. (B) Kidney
Human kidneys serve as the central organ system for monitoring and regulating blood plasma hydration and solute concentration. Specialized nephron receptors respond to osmotic shifts and hormonal signals like antidiuretic hormone. By adjusting water reabsorption versus excretion, kidneys precisely maintain systemic fluid volume, plasma osmolality, and electrolyte balance.

138. (B) Glomerulus
Chronic systemic hypertension exerts destructive mechanical stress on delicate capillary networks throughout the body. Within nephrons, high blood pressure damages delicate, high-pressure glomerular capillaries. Persistent hypertensive forces cause arteriolosclerosis, vessel thickening, and basement membrane rupture, impairing glomerular filtration and eventually leading to chronic hypertensive kidney disease.

139. (A) Uric acid
The metabolic breakdown of purine nucleotide bases, found in cellular nucleic acids, yields uric acid as an end product in humans. Under normal conditions, kidneys excrete uric acid in small quantities. Elevated blood concentrations can cause uric acid crystal precipitation inside joint cavities, triggering severe inflammatory joint pain termed gout.

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140. (C) Urea
Plants synthesize diverse secondary metabolic waste products, including plant gums, resins, latex, tannins, and essential oils, storing them in non-functional tissues or vacuoles. However, plants do not produce urea as a nitrogenous waste product because plant metabolism recycles amino groups efficiently, eliminating the need to excrete organic urea compounds.

141. (D) Urinary tract infection
Bacterial colonization of lower urinary tract structures causes acute localized mucosal inflammation. Inflammation of the urethral and bladder linings produces clinical symptoms including dysuria, persistent burning sensations during urination, elevated urinary frequency, and lower abdominal discomfort. These symptoms represent classic clinical signs of a bacterial urinary tract infection.

142. (B) 1 to 1.5 litres
Under standard conditions of fluid intake, climate, and physical activity, a healthy human adult produces approximately one to one point five liters of urine daily. While glomerular

filtration generates roughly one hundred eighty liters of initial filtrate, nephron reabsorption reclaims over ninety-nine percent, leaving a small excreted urine volume.

143. (B) It will be pale, dilute, and abundant.
Consuming excessive water reduces systemic blood osmolality, suppressing antidiuretic hormone release from the pituitary gland. Low ADH levels decrease water permeability along renal collecting ducts, inhibiting water reabsorption back into blood. Consequently, kidneys excrete large volumes of clear, highly diluted, pale yellow urine to restore normal fluid balance.

144. (D) Hypothalamus
The hypothalamus contains specialized osmoreceptor cells that continuously monitor blood plasma osmolality and solute concentration. When blood hydration decreases, osmoreceptors stimulate neural synthesis of antidiuretic hormone. ADH is transported to the posterior pituitary for blood release, signaling nephron tubules to reabsorb more water and preserve body fluid balance.

145. (A) P-4, Q-1, R-2, S-3
Human organs perform specialized excretory roles. The liver converts toxic ammonia into urea through the urea cycle. Lungs expel carbon dioxide and water vapor during respiration. Cutaneous skin glands excrete water, mineral salts, and trace urea via sweat. Kidneys perform primary blood filtration, excreting urea and regulating fluid levels.

146. (C) Birds and reptiles
Birds and reptiles are uricotelic terrestrial animals adapted to habitats where liquid water is scarce. Their metabolism converts nitrogenous waste into non-toxic, highly insoluble uric acid. Cloacal reabsorption reclaims virtually all fluid, allowing these animals to excrete uric acid as a semi-solid white paste, achieving maximum water conservation.

147. (A) Matching blood types and tissue types
Long-term success in renal transplantation depends on minimizing immunological graft rejection. Donor and recipient blood groups must be compatible, and human leukocyte antigen tissue typing must demonstrate close matching. A high degree of tissue compatibility reduces immune system activation against the transplanted organ, improving long-term graft survival outcomes.

148. (D) To prevent rejection of the new kidney
Following renal transplantation, the recipient's immune system naturally recognizes surface antigens on the donor organ as foreign non-self tissue. T-lymphocytes activate to attack and destroy the graft. Patients must take immunosuppressive medications continuously to suppress immune responses, preventing organ rejection and preserving functional transplanted kidney tissue.

149. (B) Glomerular filtrate
Hydrostatic pressure inside glomerular capillaries forces fluid plasma across filtration membranes into the cavity of Bowman's capsule. This collected fluid is designated as glomerular filtrate. Devoid of blood cells and large proteins, glomerular filtrate contains water, glucose, amino acids, mineral ions, and nitrogenous urea in concentration equal to plasma.

150. (C) Water and solute salts
The glomerular filtration membrane allows small molecules to pass freely while blocking blood cells and large proteins. Water, inorganic mineral salts, glucose, amino acids, and urea pass easily through capillary fenestrations and podocyte filtration slits. Thus, water and solute salts enter Bowman's capsule cavity as initial glomerular filtrate.

151. (D) Efferent arteriole is narrower than afferent arteriole.
High hydrostatic blood pressure inside glomerular capillaries drives ultrafiltration into Bowman's capsule. This elevated pressure results from vascular structural differences: the incoming afferent arteriole possesses a significantly wider lumen than the outgoing efferent arteriole. Vascular resistance caused by this narrower exit vessel generates high pressure within glomerular capillary beds.

152. (A) Reabsorbed in proximal tubule
Under healthy physiological conditions, all blood glucose filtered across glomerular capillaries enters the proximal convoluted tubule. Epithelial cells lining the proximal tubule utilize secondary active transport sodium-glucose cotransporters to rapidly reclaim glucose molecules. Consequently,

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one hundred percent of filtered glucose is normally reabsorbed back into peritubular capillaries.

153. (B) Conserve water and concentrate urine
A drop in systemic blood pressure or circulatory fluid volume triggers homeostatic renal reflexes. The juxtaglomerular apparatus releases renin, activating the renin-angiotensin-aldosterone system while stimulating pituitary ADH release. These hormonal pathways increase tubular water reabsorption, conserving body fluid and producing smaller volumes of hypertonic, concentrated urine.

154. (B) Smooth muscle
Ureters are bilateral tubular channels conveying urine from renal pelvises to the urinary bladder. Their thick structural walls consist of inner mucosal lining, outer adventitia, and a thick middle layer of smooth muscle tissue. Coordinated involuntary smooth muscle contractions generate peristaltic waves that actively propel urine downward toward the bladder.

155. (A) I and II
The urinary bladder is a hollow muscular sac composed of smooth detrusor muscle, designed for temporary urine storage. Urination is under complex nervous system control, combining involuntary autonomic reflexes with voluntary control over the skeletal muscle external urethral sphincter. The bladder stores urine produced by kidneys but does not manufacture urine.

156. (C) Posterior base
Ureters descend along the posterior abdominal wall into the pelvic cavity to connect with the urinary bladder. Anatomically, both ureters enter the bladder wall at its posterior base region. Entering obliquely, these openings create a natural valve mechanism that prevents backward reflux of stored urine as the bladder expands.

157. (D) Toxic wastes accumulate in the body leading to death.
Permanent double kidney failure completely halts blood filtration and waste elimination pathways. Without functioning nephrons or artificial replacement therapies like hemodialysis or organ transplantation, toxic nitrogenous wastes, urea, potassium, and acid by-products rapidly accumulate in circulating blood. Severe uremia and fluid imbalance disrupt cellular physiology, inevitably causing death.

158. (C) Toxic metabolic waste
Plants lack specialized excretory organ systems, utilizing foliar deposition to eliminate unwanted substances. Secondary metabolic by-products, heavy metal ions, and insoluble organic wastes are progressively transported and stored inside vacuoles of maturing leaves. When these senescent leaves fall off during seasonal abscission, accumulated toxic metabolic wastes are permanently removed.

159. (B) Less urea and less oxygen
Blood entering the kidney via the renal artery delivers oxygenated plasma laden with metabolic nitrogenous wastes. Inside nephrons, ultrafiltration removes urea, while kidney cells consume oxygen for active transport processes. Consequently, purified blood exiting through the renal vein contains significantly less urea and reduced oxygen concentrations compared to arterial blood.

160. (D) Thyroid gland
Excretory functions in humans are performed by primary kidneys and accessory organs like lungs, skin, and liver, which eliminate carbon dioxide, sweat salts, and bile pigments respectively. Conversely, the thyroid gland is an endocrine organ that synthesizes metabolic hormones like thyroxine, playing no role in filtering or expelling metabolic waste.

161. (A) Night
During daylight hours, plant photosynthetic activity consumes carbon dioxide rapidly, utilizing respiratory gas internally. However, in the absence of sunlight at night, photosynthesis ceases while cellular respiration continues. Plants eliminate excess carbon dioxide generated by nighttime respiration directly through open leaf stomata and stem lenticels into the surrounding air.

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162. (C) Through stomata in leaves
Photosynthesis inside plant mesophyll cells splits water molecules, producing molecular oxygen gas as a byproduct. Because plants generate more oxygen than required for cellular respiration during daylight, excess gaseous oxygen is expelled. Diffusing through intercellular spaces,

CHAPTER 05

Animal Nervous System

1. Which organ system in animals is primarily responsible for rapid coordination and control of body activities?
(A) Endocrine system
(B) Nervous system
(C) Circulatory system
(D) Excretory system

2. What is the fundamental structural and functional unit of the nervous system?
(A) Neuron
(B) Nephron
(C) Alveolus
(D) Villi

3. Which of the following best describes the primary function of the nervous system?
(A) Transporting oxygen and nutrients to body tissues
(B) Digesting and absorbing complex nutrients in gut
(C) Receiving stimuli and generating rapid responses
(D) Producing gametes and hormones for reproduction

4. Which part of the neuron is primarily responsible for receiving information from other cells or the environment?
(A) Axon
(B) Myelin sheath
(C) Nerve ending
(D) Dendrite

5. In a neuron, where is the nucleus primarily located?
(A) In the axon terminal
(B) In the dendrites
(C) In the cell body
(D) In the myelin sheath

6. What is the long fibre-like structure of a neuron that carries impulses away from the cell body?
(A) Dendrite
(B) Axon
(C) Cyton
(D) Synapse

7. The branched endings of an axon are responsible for which of the following actions?
(A) Absorbing essential nutrients for neuronal metabolism
(B) Generating initial electrical action potentials
(C) Protecting cell bodies from external physical impact
(D) Transmitting the nerve impulse to the next neuron

8. Which type of neuron carries impulses from the sense organs to the central nervous system?
(A) Sensory neuron
(B) Motor neuron
(C) Association neuron
(D) Effector neuron

9. What is the function of motor neurons in the nervous system?
(A) To carry incoming signals from sensory receptors to the brain
(B) To connect neighboring sensory neurons directly to each other
(C) To carry signals from the central nervous system to effectors
(D) To store and synthesize neurotransmitters in spinal cord neurons

10. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Relay neurons are found within the central nervous system.
Reason (R): Relay neurons serve as a link between sensory neurons and motor neurons.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

11. Which term is used for neurons that process information and connect different types of neurons within the brain and spinal cord?
(A) Sensory neurons

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173. (D) Hilum
The medial concave border of each human kidney features a deep longitudinal fissure termed the renal hilum. This anatomical entrance and exit point allows major renal blood vessels, lymphatic vessels, autonomic nerves, and the wide funnel-shaped renal pelvis to enter or leave the internal kidney structure cleanly.

174. (C) Loop of Henle
Nephron components are distributed specifically across renal regions. Renal corpuscles and convoluted tubules reside within the outer cortex. Conversely, the U-shaped loop of Henle extends deeply into the inner renal medulla. The descending and ascending limbs pass through medullary tissue, establishing osmotic gradients required for urine concentration.

175. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Hemodialysis relies on physical principles of passive diffusion and osmosis across semi-permeable membranes. Blood flows through artificial tubing surrounded by dialysing fluid containing no nitrogenous wastes. Toxic metabolic wastes like urea diffuse down steep concentration gradients from blood into dialysate fluid, restoring normal blood solute composition safely.

176. (D) Plants can store wastes in leaves that fall off.
Plants lack complex excretory organ systems, managing metabolic by-products through decentralized cellular strategies. Organic wastes and mineral salts accumulate inside cellular vacuoles, stems, bark, or maturing leaves. As old foliage undergoes seasonal senescence and drops off, plants successfully discard accumulated internal wastes, confirming effective waste removal.

177. (A) Krebs and Henseleit
The biochemical pathway converting toxic ammonia into urea was elucidated in 1932 by biochemists Hans Krebs and Kurt Henseleit. Known as the Krebs-Henseleit urea cycle, this landmark discovery identified the cyclical enzymatic reactions occurring within liver mitochondria and cytosol that neutralize nitrogenous waste products in ureotelic organisms.

178. (C) It decreases.
Ingesting a large volume of water dilutes blood plasma, decreasing systemic osmotic pressure. Hypothalamic osmoreceptors detect reduced solute concentration and inhibit antidiuretic hormone synthesis and pituitary release. Reduced circulating ADH decreases nephron collecting duct water permeability, causing kidneys to excrete abundant dilute urine to maintain normal fluid balance.

179. (A) Incontinence
Urinary incontinence is a medical condition characterized by the involuntary leakage of urine from the bladder. This condition occurs when muscular sphincter muscles surrounding the urethra lose structural integrity or neural control, failing to maintain adequate bladder closure during rising intra-abdominal pressure or detrusor muscle contractions.

180. (D) Active secretion
Tubular secretion is an active transport process occurring along nephron epithelial membranes during urine formation. Specialized tubular transport proteins expend cellular ATP to transfer metabolic waste products, excess hydrogen ions, potassium ions, and organic drugs like penicillin directly from peritubular capillaries into tubular fluid for elimination in urine.

181. (B) Female urethra is shorter and near the anus.
Urinary tract infections occur far more frequently in human females due to distinct anatomical characteristics. The female urethra measures approximately four centimeters in length, significantly shorter than the male urethra. Additionally, its close physical proximity to the anal orifice allows gastrointestinal bacteria like Escherichia coli to enter easily.

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182. (C) Dietary sodium and oxalate
Dietary modification plays a critical role in preventing renal calculus recurrence. Reducing dietary sodium intake lowers urinary calcium excretion, while restricting oxalate-rich foods minimizes calcium oxalate crystal formation. Combining these dietary limitations with ample water hydration effectively prevents crystal nucleation and growth within the urinary tract.

183. (D) Sputum
Human excretory mechanisms eliminate metabolic waste by-products generated by

(B) Nerves connecting the central nervous system to the body
(C) Nerves running exclusively inside the protective vertebral column
(D) Neural circuits responsible solely for local involuntary reflexes

23. Nerves that emerge directly from the brain are known as:
(A) Spinal nerves
(B) Autonomic nerves
(C) Cranial nerves
(D) Motor nerves

24. Nerves that arise from the spinal cord and spread throughout the body are called:
(A) Cranial nerves
(B) Olfactory nerves
(C) Optic nerves
(D) Spinal nerves

25. Consider the following statements about the human nervous system:
I. The central nervous system consists of the brain and spinal cord.
II. The peripheral nervous system facilitates communication between the CNS and body parts.
III. Cranial nerves arise from the spinal cord.
IV. Sensory nerves bring information from tissues to the CNS.
Which combination of statements is correct?
(A) I, II, and III
(B) I, II, and IV
(C) II, III, and IV
(D) I, III, and IV

26. Which of the following is defined as a quick, sudden, and involuntary response of the body to a stimulus?
(A) Voluntary action
(B) Reflex action
(C) Conscious thought
(D) Delayed reaction

27. Pulling your hand away rapidly after touching a hot object is an example of which physiological process?
(A) Conditioned reflex
(B) Voluntary motor response
(C) Habituation
(D) Reflex action

28. Which part of the central nervous system primarily controls most simple reflex actions?
(A) Spinal cord
(B) Cerebral cortex
(C) Cerebellar hemisphere
(D) Medulla oblongata

29. The pathway taken by nerve impulses in a reflex action is called a:
(A) Reflex pathway
(B) Synaptic cleft
(C) Reflex arc
(D) Motor route

30. In a typical reflex arc, which structure detects the stimulus?
(A) Receptor
(B) Effector
(C) Motor neuron
(D) Relay neuron

31. Which component of a reflex arc carries the response signal to a muscle or gland?
(A) Sensory neuron
(B) Receptor
(C) Spinal cord
(D) Motor neuron

32. What is the effector organ in the reflex action of withdrawing a hand from a sharp pin?
(A) The epidermal tissue of the hand
(B) The biceps muscle of the arm
(C) The afferent sensory nerve fibre
(D) The central spinal cord segment

33. Why are reflex actions essential for the survival of an animal?
(A) They require detailed conscious thinking and deliberate motor planning
(B) They allow the cerebral cortex to execute complex spatial calculations
(C) They protect the body from harm through rapid responses
(D) They continuously slow down autonomic heart rate during deep sleep states

34. Which of the following statements about the reflex arc is incorrect?
(A) It relies on both sensory and motor neurons working in coordination.
(B) It provides an exceptionally fast involuntary response to a stimulus.
(C) It includes a specific effector organ that carries out the response.
(D) It relies on the brain for executing simple withdrawal responses.

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is less harmful than ammonia, elevated blood concentrations lead to severe uremia. Accumulating urea disrupts cellular osmolality, inhibits enzymatic activity, and alters pH balance, necessitating continuous kidney filtration to prevent metabolic toxicity.

194. (C) Become severely dehydrated
Nephrons normally reabsorb over ninety-nine percent of the one hundred eighty liters of fluid filtered daily. Complete failure of renal tubular water reabsorption would result in the rapid excretion of enormous volumes of extremely dilute urine. Without continuous fluid replacement, massive water loss would cause fatal systemic dehydration within hours.

195. (A) I and II
Kidney stones represent solid mineral aggregates, primarily calcium oxalate or uric acid, formed inside renal passages. Passing through narrow ureters, stones obstruct urine drainage and trigger intense, painful muscular spasms. Dehydration accelerates stone formation; drinking ample water dilutes urinary solutes, preventing crystal aggregation rather than causing stones.

196. (D) Renal artery
Oxygenated blood containing metabolic nitrogenous wastes is delivered directly to each kidney by the renal artery. Branching directly from the abdominal aorta at right angles, this large blood vessel carries roughly twenty percent of total cardiac output into renal vascular networks, supplying high-pressure blood required for continuous glomerular filtration.

197. (B) Mangroves (halophytes)
Halophytic plants such as coastal mangroves inhabit hypertonic saline environments high in sodium chloride. To prevent toxic salt accumulation, mangroves utilize specialized salt glands on leaf surfaces to actively excrete excess absorbed salts. This specialized excretory adaptation preserves internal water balance and prevents cellular salt toxicity.

198. (C) I, II, and III
The human excretory system operates through coordinated organs. Kidneys filter blood plasma to produce urine, which is conveyed downward by paired muscular ureters. The urinary bladder provides temporary urine storage. However, the urethra transports urine from the bladder to the exterior, not from kidneys to the bladder.

199. (D) Antibiotics and increased fluid intake
Uncomplicated urinary tract infections are bacterial conditions affecting mucosal linings of lower urinary passages. Clinical management involves administering targeted antibiotic medications to eradicate pathogenic bacteria. Simultaneously increasing daily fluid intake promotes frequent urination, mechanically flushing multiplying bacteria and toxic cellular debris out of the urinary tract.

200. (A) Hydration, balanced diet, and hygiene
Preserving long-term excretory health requires integrated lifestyle practices. Adequate daily hydration ensures high urine volume to prevent calculus formation. A balanced diet low in excess sodium and processed oxalates minimizes renal strain. Good personal hygiene prevents ascending urinary bacterial infections, together ensuring optimal kidney and urinary tract function.

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oxygen gas escapes into the atmosphere primarily through open leaf stomata openings.

163. (A) Human body cells
The dual processes of excretion and osmoregulation continuously regulate solute concentrations and water volume in extracellular fluids. By precisely controlling blood plasma osmolality, kidneys ensure that circulating blood remains isotonic to surrounding human body cells. Maintaining osmotic fluid equilibrium prevents destructive water movement, protecting body cells from swelling or shrinking.

164. (D) Tea/Coffee
Diuretics are chemical substances that increase urine production by inhibiting nephron sodium and water reabsorption. Beverages containing caffeine, such as tea and coffee, act as mild natural diuretics. Caffeine inhibits adenosine receptors and reduces tubular solute reabsorption, promoting increased fluid excretion through the kidneys and bladder.

165. (B) I, II, and III
Urinalysis serves as a vital clinical diagnostic tool for detecting diverse health disorders. Testing urine reveals urinary tract infections via bacterial detection, kidney damage through abnormal protein presence, and diabetes mellitus via glycosuria. However, urine analysis evaluates renal and metabolic status, providing no information regarding pulmonary total lung capacity.

166. (C) Increase daily water intake significantly
Medical dietary guidelines for preventing recurrent nephrolithiasis emphasize increasing daily fluid intake. Consuming substantial quantities of water expands total urine volume, lowering concentrations of calcium, oxalate, and uric acid solutes. Maintaining dilute urine prevents crystal nucleation and aggregation, effectively halting the formation of painful kidney stones.

167. (D) Frog
Vertebrate embryonic development exhibits evolutionary variations in renal anatomy. Higher terrestrial vertebrates like reptiles, birds, and mammals develop advanced metanephric kidneys during adult stages. Conversely, adult amphibians such as frogs retain a mesonephric kidney structure, reflecting an intermediate evolutionary adaptation suitable for semi-aquatic lifestyles and moist environments.

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168. (A) Conserve water
Humans produce hypertonic urine that is significantly more concentrated than blood plasma. This physiological capability relies on deep medullary osmotic gradients generated by loops of Henle and collecting ducts under antidiuretic hormone stimulation. Concentrating urine allows the body to excrete required daily solute loads while conserving vital body water.

169. (B) Transitional epithelium
The inner mucosal lining of the human urinary bladder is composed of specialized stratified epithelium termed transitional epithelium or urothelium. Possessing unique stretchable umbrella cells, transitional epithelium allows the bladder wall to expand significantly without tearing as urine volume increases, providing a waterproof protective barrier against hypertonic urine.

170. (B) It actively reabsorbs water into the blood.
The urethra is a muscular tubular canal whose primary physiological function is conveying urine from the urinary bladder to the body exterior. Anatomically longer in males where it also transports semen, the urethra functions strictly as an excretory conduit and possesses no specialized transport epithelium for active reabsorption of water.

171. (A) Only urine
Human female anatomy features complete physical separation between urinary and reproductive pathways. The female urethra is a short tube measuring roughly four centimeters, dedicated exclusively to conveying urine from the bladder to the external urethral orifice. Reproductive functions occur through a separate vaginal canal, unlike male shared urethral structures.

172. (C) Vascular pole
Each renal corpuscle exhibits distinct structural polarity. The region where the wider afferent arteriole enters and the narrower efferent arteriole exits the glomerulus at Bowman's capsule is designated as the vascular pole. Directly opposite lies the urinary pole, where filtrate empties into the proximal convoluted tubule for reabsorption.

(B) Motor neurons
(C) Receptor cells
(D) Association neurons

12. A nerve impulse travels through a neuron in which electrical form?
(A) Static electricity
(B) Electrical signal
(C) Chemical precipitate
(D) Magnetic wave

13. Which of the following is essential for the generation of a nerve impulse in a receptor?
(A) The presence of red blood cells
(B) A decrease in body temperature
(C) A physical or chemical stimulus
(D) The secretion of digestive enzymes

14. What occurs when a nerve impulse reaches the end of an axon?
(A) The neuron immediately dies due to energy exhaustion
(B) The electrical signal reverses its direction in the axon
(C) The axon merges directly with a surrounding blood vessel
(D) Chemicals called neurotransmitters are released

15. Consider the following statements about the transmission of nerve impulses:
I. Information is acquired at the dendritic tip of a nerve cell.
II. The electrical impulse travels from the dendrite to the cell body, and then along the axon.
III. At the axon ending, the electrical impulse directly enters the next neuron without any chemical change.
Which combination is correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II and III

16. What is the microscopic gap between a terminal branch of one neuron and the dendrite of another neuron called?
(A) Node of Ranvier
(B) Synapse
(C) Cyton
(D) Axon hillock

17. The transfer of a signal across a synapse is achieved by which of the following?
(A) Direct physical contact of cellular membranes
(B) Diffusion of chemical neurotransmitters
(C) Jumping of an electrical spark
(D) Capillary blood flow

18. Why is the transmission of a nerve impulse across a synapse strictly unidirectional?
(A) Because neurotransmitters are released only at axon terminals
(B) Because dendrites lack protective myelin sheaths for conduction
(C) Because the central spinal cord actively blocks all reverse signals
(D) Because structural axons are vastly longer than receiving dendrites

19. Which of the following best describes a neurotransmitter?
(A) An electrical wave moving continuously along the neuronal axon
(B) A protective insulation sheath surrounding the central nerve fibre
(C) A chemical messenger that crosses the synaptic gap
(D) A structural cell providing metabolic support to adjacent neurons

20. Match List-I with List-II:
List I: (Receptor Type)
P. Photoreceptor
Q. Phonoreceptor
R. Olfactory receptor
S. Gustatory receptor
List II: (Sense Organ)
1. Tongue
2. Nose
3. Eye
4. Ear
(A) P-3, Q-4, R-2, S-1
(B) P-4, Q-3, R-1, S-2
(C) P-3, Q-4, R-1, S-2
(D) P-4, Q-3, R-2, S-1

21. Which two main components make up the Central Nervous System (CNS) in humans?
(A) Spinal cord and cranial nerves
(B) Brain and autonomic nerves
(C) Cranial nerves and spinal nerves
(D) Brain and spinal cord

22. The Peripheral Nervous System (PNS) consists of which of the following?
(A) Nerves confined strictly within the central bony skull structure

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cellular chemical processes. Urea and uric acid represent nitrogenous wastes excreted in urine, while carbon dioxide is a gaseous metabolic waste expelled through lungs. Conversely, sputum is a mucous secretion from respiratory passages rather than a cellular metabolic waste product.

184. (A) First thing in the morning
During overnight sleep, fluid intake ceases for several hours while body metabolism continues normally. Elevated nocturnal antidiuretic hormone secretion increases water reabsorption along nephron collecting ducts. Consequently, the first morning urine sample exhibits maximum osmolality, solute concentration, and dark yellow coloration due to prolonged water conservation.

185. (B) P-3, Q-1, R-4, S-2
Sequential steps in urine production correlate with specific anatomical structures. High-pressure ultrafiltration occurs at the glomerulus inside Bowman's capsule. Selective tubular reabsorption reclaims nutrients along renal tubule segments. Formed urine accumulates for temporary storage inside the muscular urinary bladder before descending through ureters toward the body exterior.

186. (B) Reduced sweating increases urine volume to maintain water balance.
Environmental cold temperatures reduce cutaneous blood flow and significantly diminish perspiration rates from sweat glands. Because less body water is lost through cutaneous evaporation during winter, kidneys compensate to maintain fluid homeostasis. Increased blood volume triggers higher glomerular filtration and reduced ADH release, producing larger urine volumes.

187. (A) Blood plasma
Urea synthesized in the liver during amino acid deamination is a water-soluble organic solute. Released into hepatic veins, urea dissolves directly into liquid blood plasma rather than binding to cellular components. Circulating plasma transports dissolved urea through systemic blood vessels to renal arteries for nephron filtration.

188. (C) Millions of nephrons filtering blood
Continuous blood purification relies on microscopic functional filtering units within human kidneys. Each kidney houses approximately one million nephrons, providing an enormous total filtration surface area. Dense capillary networks and specialized tubular epithelium inside these nephrons continuously process circulating blood, extracting metabolic wastes while reabsorbing essential substances.

189. (D) Leather tanning
Tannins are complex polyphenolic plant waste products found abundant in tree bark and leaves. In industrial applications, extracted tannins possess unique chemical properties that bind to and cross-link collagen proteins in animal hides. This cross-linking process stabilizes raw skins into durable leather, making tannins invaluable in leather tanning.

190. (C) A plant waste or secretory product
Plant latex is a complex emulsion containing resins, gums, proteins, and hydrocarbons stored inside specialized laticifer cells. Produced by rubber trees, latex functions as a plant secretory product or metabolic waste that helps seal plant wounds and deters herbivorous insects. Harvested latex forms the primary raw material for natural rubber production.

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191. (B) Maintaining a steep concentration gradient for diffusion
Hemodialysis utilizes counter-current flow, channeling patient blood and fresh dialysing fluid in opposite directions across semi-permeable membranes. This arrangement maintains a consistent concentration gradient along the entire tubing length. Consequently, continuous diffusion of urea, creatinine, and excess solutes from blood into dialysate occurs with maximum efficiency.

192. (D) Human - Nephrons
Animal groups utilize structurally distinct excretory systems adapted to their evolutionary lineages. Earthworms excrete wastes using segmental nephridia, insects like cockroaches employ Malpighian tubules, and aquatic fishes excrete ammonia primarily through gill membranes. Humans, like all mammals, rely on millions of microscopic nephrons within paired kidneys for filtration.

193. (A) It becomes toxic in the blood
Protein metabolism continuously generates nitrogenous by-products that accumulate in circulating blood plasma. Although urea

35. Choose the correct sequence of a reflex arc pathway:
(A) Receptor → Motor neuron → Spinal cord → Sensory neuron → Effector
(B) Receptor → Sensory neuron → Spinal cord → Motor neuron → Effector
(C) Effector → Motor neuron → Spinal cord → Sensory neuron → Receptor
(D) Receptor → Sensory neuron → Brain → Motor neuron → Effector

36. The autonomic nervous system primarily regulates which type of actions?
(A) Voluntary motor actions such as walking and running
(B) Involuntary actions like heartbeat and digestion
(C) Conscious thought processes and memory storage
(D) Skeletal muscle movements during heavy exercise

37. Which two subdivisions make up the autonomic nervous system?
(A) Central division and peripheral division
(B) Cranial nervous system and spinal system
(C) Sympathetic and parasympathetic systems
(D) Sensory pathways and motor nerve pathways

38. How do the sympathetic and parasympathetic nervous systems generally interact with target organs?
(A) They produce completely identical physiological effects on all target organs.
(B) Only the sympathetic system regulates internal organs during homeostatic stress.
(C) They exclusively act to inhibit organ function across all anatomical tissue types.
(D) They have antagonistic (opposite) effects on most internal organs.

39. During a "fight or flight" emergency situation, which part of the nervous system dominates?
(A) Sympathetic nervous system
(B) Parasympathetic nervous system
(C) Central nervous system alone
(D) Somatic nervous system

40. Which of the following is an effect of the sympathetic nervous system?
(A) Increasing the heart rate
(B) Decreasing the heart rate
(C) Stimulating digestion
(D) Constricting the pupils

41. Which system acts to restore the body to a state of calm, often referred to as "rest and digest"?
(A) Sympathetic nervous system division
(B) Somatic motor nervous system
(C) Parasympathetic nervous system
(D) Voluntary somatic nervous system

42. What effect does the parasympathetic nervous system have on the digestive process?
(A) It stimulates and promotes digestion
(B) It completely stops digestion
(C) It inhibits salivary gland secretion
(D) It redirects blood away from the stomach

43. Sense organs are specialized structures designed to:
(A) Digest ingested food materials and absorb key nutrients
(B) Pump oxygenated blood continuously to distal body tissues
(C) Store toxic metabolic waste products prior to excretion
(D) Detect specific stimuli from the environment

44. Which of the following is NOT considered a primary sense organ in humans?
(A) Eye
(B) Liver
(C) Ear
(D) Skin

45. Determine the correct order of events when a stimulus is detected by a sense organ:
1. Sensory neuron transmits the impulse
2. Receptor detects the stimulus
3. Brain interprets the signal
4. Impulse reaches the central nervous system
(A) 2, 1, 4, 3
(B) 1, 2, 3, 4
(C) 2, 4, 1, 3
(D) 4, 3, 2, 1

46. The sense organ primarily responsible for detecting changes in environmental temperature is the:
(A) Eye
(B) Tongue
(C) Ear
(D) Skin

47. Which specialized receptors are present in the nasal cavity?
(A) Olfactory receptors
(B) Gustatory receptors
(C) Photoreceptors

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(D) Phonoreceptors

48. Gustatory receptors are primarily located in which organ?
(A) Nose
(B) Tongue
(C) Skin
(D) Ear

49. The transparent front part of the human eye that allows light to enter is called the:
(A) Retina
(B) Cornea
(C) Iris
(D) Optic nerve

50. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The pupil changes its size depending on the intensity of light.
Reason (R): The iris controls the amount of light entering the eye by adjusting the pupil size.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

51. In the human eye, which structure acts as a light-sensitive screen where the image is formed?
(A) Lens
(B) Cornea
(C) Retina
(D) Pupil

52. The image formed on the retina of the human eye is typically:
(A) Virtual and erect
(B) Virtual and inverted
(C) Real and erect
(D) Real and inverted

53. Which cells on the retina respond to the intensity of light and help in twilight vision?
(A) Cone cells
(B) Ganglion cells
(C) Rod cells
(D) Epithelial cells

54. Which cells on the retina are responsible for colour vision?
(A) Rod cells
(B) Cone cells
(C) Bipolar cells
(D) Schwann cells

55. Consider the following statements about the human eye:
I. The crystalline lens provides the finer adjustment of focal length.
II. The optic nerve carries visual information to the brain.
III. The blind spot has the highest concentration of photoreceptor cells.
Which combination is correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II and III

56. What is the role of the crystalline lens in the human eye?
(A) It focuses light rays onto the retina.
(B) It supplies nutrient-rich blood directly to the retina.
(C) It protects the outer transparent cornea from floating dust.
(D) It determines the characteristic visible colour of the eye.

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57. The ability of the eye lens to adjust its focal length is known as:
(A) Refraction
(B) Reflection
(C) Accommodation
(D) Dispersion

58. Which structure carries electrical signals from the retina to the brain?
(A) Optic nerve
(B) Auditory nerve
(C) Olfactory nerve
(D) Spinal nerve

59. The visible coloured part of the human eye is called the:
(A) Cornea
(B) Pupil
(C) Retina
(D) Iris

60. Match List-I with List-II:
List I: (Part of Eye)
P. Cornea
Q. Iris
R. Lens
S. Retina
List II: (Function)

1. Controls pupil size
2. Light-sensitive screen
3. Outer transparent covering
4. Focuses light

(A) P-3, Q-1, R-4, S-2
(B) P-1, Q-3, R-2, S-4
(C) P-3, Q-4, R-1, S-2
(D) P-4, Q-1, R-3, S-2

61. Which part of the human ear collects sound waves from the surroundings?
(A) Cochlea
(B) Tympanic membrane
(C) Pinna
(D) Auditory nerve

62. The tympanic membrane in the ear is commonly known as the:
(A) Hammer
(B) Anvil
(C) Stirrup
(D) Eardrum

63. What happens to the eardrum when sound waves reach it?
(A) It vibrates
(B) It becomes rigid
(C) It produces a chemical liquid
(D) It changes colour

64. The middle ear contains three small bones which function to:
(A) Convert mechanical sound vibrations directly into electrical signals
(B) Amplify vibrations received from the eardrum
(C) Collect incoming external sound waves from the surrounding air
(D) Maintain the spatial balance and posture of the human body

65. Consider the following statements about the human ear:
I. The outer ear is called the pinna.
II. The middle ear contains the hammer, anvil, and stirrup bones.
III. The cochlea is located in the inner ear.
IV. The auditory nerve carries visual signals to the brain.
Which combination of statements is correct?
(A) I, II, and III
(B) I, II, and IV
(C) II, III, and IV
(D) I, III, and IV

66. In the inner ear, which coiled structure turns pressure variations into electrical signals?
(A) Cochlea
(B) Pinna
(C) Auditory canal
(D) Eustachian tube

67. Which nerve transmits electrical signals from the cochlea to the brain?
(A) Optic nerve
(B) Olfactory nerve
(C) Auditory nerve
(D) Vagus nerve

68. Apart from hearing, the inner ear also plays a crucial role in which bodily function?
(A) Digestion and nutrient absorption in gut
(B) Regulating core internal body temperature
(C) Producing mature red blood cells in marrow
(D) Maintaining body balance and posture

69. Why is coordination between the nervous system and the endocrine system necessary?
(A) Because the endocrine system uses rapid electrical impulses across synapses
(B) Because hormones are produced directly by central sensory nerve cells
(C) Because the nervous system cannot reach every single cell in the body
(D) Because the central brain only regulates involuntary autonomic actions

70. How does the endocrine system differ from the nervous system in terms of signal transmission?
(A) The endocrine system uses high-speed electrical action potentials, whereas the nervous system relies on blood hormones.
(B) The endocrine system relies on chemical messengers in the blood, which is slower than nerve impulses.
(C) The endocrine system acts exclusively on skeletal voluntary muscle tissue during conscious motor movements.
(D) The endocrine system signals decay rapidly within a fraction of a second after being secreted by glands.

71. When an animal encounters a dangerous situation, which two systems coordinate to prepare the body for action?
(A) Excretory and respiratory systems
(B) Digestive and skeletal systems
(C) Reproductive and circulatory systems
(D) Nervous and endocrine systems

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72. What acts as a protective bony structure around the spinal cord?
(A) Vertebral column
(B) Cranium
(C) Rib cage
(D) Pelvic girdle

73. The spinal cord is an extension of which part of the brain?
(A) Cerebrum
(B) Cerebellum
(C) Medulla
(D) Hypothalamus

74. Which fluid surrounds and protects the brain and spinal cord from mechanical shocks?
(A) Cerebrospinal fluid
(B) Blood plasma
(C) Lymph
(D) Synovial fluid

75. The spinal cord plays a major role in controlling:
(A) Complex mathematical calculations
(B) Olfactory sensation
(C) Hormone synthesis
(D) Reflex actions below the neck

76. An injury to the spinal cord is most likely to disrupt which of the following?
(A) Digestion of complex starch molecules in the mouth cavity
(B) Reflex arcs and voluntary movements in affected limbs
(C) Production and storage of digestive bile in the liver
(D) Focusing adjustments of the crystalline eye lens system

77. The term "paralysis" generally refers to:
(A) Excessive overproduction and accumulation of cerebrospinal fluid in ventricles
(B) Dramatically enhanced ability to conduct rapid electrical nerve impulses
(C) Loss of muscle function and voluntary movement due to nerve damage
(D) Acute systemic inflammation of the peripheral auditory nerve pathway

78. Which of the following is a common nervous system disorder characterized by recurrent seizures due to abnormal electrical activity in the brain?
(A) Diabetes
(B) Asthma
(C) Scurvy
(D) Epilepsy

79. During a seizure in an epileptic patient, what primarily happens in the brain?
(A) Sudden, disorganized bursts of electrical nerve impulses occur
(B) Cerebral blood flow completely stops throughout the entire vascular bed
(C) All cerebral neurons instantly undergo programmed cell death processes
(D) Cerebrospinal fluid rapidly drains out of the cranial cavity entirely

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80. Nervous tissue is primarily composed of which distinct type of cells?
(A) Muscle fibers
(B) Neurons (nerve cells)
(C) Epithelial cells
(D) Red blood cells

81. Which structure in a neuron is specifically adapted to speed up the transmission of a nerve impulse?
(A) Nucleus
(B) Myelin sheath
(C) Mitochondria
(D) Ribosome

82. What is the primary function of the myelin sheath?
(A) To act as an electrical insulator and increase impulse speed
(B) To provide metabolic nourishment continuously to brain tissue
(C) To identify and destroy damaged or degenerating neurons rapidly
(D) To synthesize and store chemical neurotransmitters in axons

83. The gaps in the myelin sheath along an axon are known as:
(A) Synaptic clefts
(B) Dendritic spines
(C) Nodes of Ranvier
(D) Axon terminals

84. Which of the following best describes the speed of nerve impulse conduction?
(A) It is extremely slow, taking hours to travel across the body
(B) It travels at the speed of light
(C) It only moves during sleep
(D) It is very rapid, allowing for immediate bodily responses

85. Choose the correct sequence of the path of light through the human eye:
(A) Retina → Lens → Pupil → Cornea
(B) Cornea → Pupil → Lens → Retina
(C) Lens → Cornea → Retina → Pupil
(D) Pupil → Cornea → Retina → Lens

86. How does a single nerve impulse ensure it does not travel backward along the axon?
(A) The central spinal cord actively blocks reverse electrical current flow
(B) The refractory period of the membrane prevents backward conduction
(C) Thick myelin insulation physically blocks the reverse signal pathway
(D) Earth's gravitational pull continuously pulls the impulse forward

87. During embryonic development, the nervous system is formed from which primary germ layer?
(A) Endoderm
(B) Mesoderm
(C) Epidermis
(D) Ectoderm

88. Why is the proper formation of the nervous system critical during embryonic development?
(A) Because it coordinates the development and function of organ systems
(B) Because it provides the primary rigid structural support similar to a skeleton
(C) Because it directly forms the lining and tissue layers of the digestive tract
(D) Because it produces mature red blood cells required by the developing fetus

89. A chemical substance that acts as a neurotransmitter at many synapses is:
(A) Amylase
(B) Hemoglobin
(C) Acetylcholine
(D) Insulin

90. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Myelinated nerve fibres conduct impulses faster than non-myelinated fibres.
Reason (R): The myelin sheath acts as an insulator, allowing the electrical signal to jump from node to node.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

91. Severe mental stress can negatively affect the nervous system by causing:
(A) Dramatically enhanced reflex response speed
(B) Uncontrolled regenerative growth of new limbs
(C) Complete biological immunity to all viral infections
(D) Impaired memory, fatigue, and poor coordination

92. The brain is situated in a bony box known as the:
(A) Thoracic cage
(B) Cranium
(C) Vertebral arch
(D) Sternum

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93. Which part of the human brain is considered the main thinking part?
(A) Hindbrain
(B) Midbrain
(C) Cerebrum (Forebrain)
(D) Medulla

94. The cerebrum is primarily responsible for:
(A) Automatically controlling the resting rate of heartbeat
(B) Executing simple spinal reflex actions like knee-jerk
(C) Chemical digestion and nutrient breakdown of food
(D) Voluntary actions, memory, and cognitive learning

95. Consider the following statements about the human brain:
I. The hindbrain includes the cerebellum, pons, and medulla.
II. The cerebellum is responsible for maintaining posture and balance.
III. The medulla controls voluntary movements like writing.
Which combination is correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II and III

96. Involuntary actions such as blood pressure, salivation, and vomiting are controlled by the:
(A) Cerebrum

dendrites on its cell body.

121. The chemical substances responsible for transmitting impulses across a synapse are called:
(A) Hormones
(B) Enzymes
(C) Neurotransmitters
(D) Antibodies

122. Which receptors in the human body detect the flavour of food?
(A) Gustatory receptors
(B) Olfactory receptors
(C) Photoreceptors
(D) Thermoreceptors

123. The loss of olfactory receptors would result in the inability to:
(A) Hear high-pitched sounds
(B) Detect variations in temperature
(C) See in dim light
(D) Smell odours

124. When a person steps on a sharp stone, the pain is detected by receptors in the skin and the signal travels towards the spinal cord via:
(A) Motor neurons
(B) Sensory neurons
(C) Relay neurons
(D) Autonomic nerves

125. The speed of a nerve impulse is significantly increased if the axon:
(A) Is significantly shorter in overall length
(B) Lacks a functional cell body or nucleus
(C) Is covered by an insulating myelin sheath
(D) Has no receptive dendrites on its soma

126. Which type of nervous tissue is highly specialized for being stimulated and then transmitting the stimulus rapidly?
(A) Connective tissue
(B) Muscular tissue
(C) Epithelial tissue
(D) Nervous tissue

127. Which of the following is NOT a part of the peripheral nervous system?
(A) Spinal cord
(B) Cranial nerves
(C) Spinal nerves
(D) Sensory nerve fibers

128. Why does the body need the endocrine system if the nervous system provides rapid control?
(A) Because electrical nerve impulses temporarily cease functioning entirely during deep sleep cycles
(B) Because nerve impulses cannot reach every cell, while blood hormones diffuse widely
(C) Because endocrine chemical hormones travel considerably faster through blood than nerve signals
(D) Because the central brain exclusively controls digestive processes and ignores cellular growth

129. How do animal cells change their shape in response to a nerve impulse?
(A) By rapidly absorbing large quantities of extracellular water molecules
(B) By rearranging specialized muscle proteins inside the cell
(C) By undergoing mitotic division to split directly into two cells
(D) By shedding their outer cellular membrane into tissue spaces

130. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The nervous system and the endocrine system work together to control and coordinate body functions.
Reason (R): The nervous system provides rapid, short-lived responses, while the endocrine system provides slower, long-lasting responses.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

131. Which of the following acts as the main integrating centre of the body?
(A) Spinal cord
(B) Heart
(C) Brain
(D) Kidney

132. What is a bundle of nerve fibres enclosed in a tubular sheath called?
(A) A muscle
(B) A tendon
(C) A blood vessel
(D) A nerve

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of another

108. Which component is entirely absent in a non-myelinated neuron?
(A) Cell body
(B) Myelin sheath
(C) Dendrite
(D) Axon

109. An involuntary response to a stimulus that does not involve the brain initially is called a:
(A) Voluntary action
(B) Synaptic delay
(C) Reflex action
(D) Conscious reaction

110. Which of the following best describes the "blind spot" in the human eye?
(A) The central focal area of the retina densely populated with light-sensitive cones
(B) The outer structural region of the transparent cornea that becomes opaque
(C) The central crystalline section of the eye lens that cannot adjust focus
(D) The spot on the retina where the optic nerve exits lacking photoreceptors

111. What is the function of the pupil in the eye?
(A) It acts as an aperture allowing light to enter
(B) It precisely focuses incoming light rays onto the retina surface
(C) It mechanically protects the delicate outer eye surface from dust
(D) It continuously provides essential metabolic nutrition to the cornea

112. The black appearance of the pupil is due to:
(A) The dense accumulation of dark melanic pigment within the anterior cornea
(B) The absorption of light rays entering it without reflection back
(C) The deep natural black pigmentation covering the optic nerve pathway
(D) The continuous structural shadow cast across the eye by upper eyelids

113. In dim light, the pupil of the eye:
(A) Becomes completely closed off by sphincter contraction
(B) Dilates to allow more light to enter
(C) Constricts tightly to reduce incoming light rays drastically
(D) Remains completely unchanged regardless of illumination

114. The pinna of the ear is composed of which flexible tissue?
(A) Cartilage
(B) Bone
(C) Muscle
(D) Ligament

115. Arrange the parts of the human ear in the order sound waves travel through them:
1. Eardrum
2. Pinna
3. Cochlea
4. Middle ear bones

(A) 2, 1, 4, 3
(B) 2, 4, 1, 3
(C) 1, 2, 4, 3
(D) 3, 4, 1, 2

116. Which system is responsible for controlling the contraction of the heart muscle?
(A) Somatic nervous system
(B) Central nervous system directly
(C) Skeletal nervous system
(D) Autonomic nervous system

117. Increased sweating and pupil dilation during a scary situation are triggered by the:
(A) Parasympathetic nervous system
(B) Central nervous system
(C) Sympathetic nervous system
(D) Olfactory nerve

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118. Which structural part of the brain connects the brain to the spinal cord?
(A) Cerebrum
(B) Medulla
(C) Cerebellum
(D) Cranium

119. A microscopic gap across which nerve impulses pass from one neuron to the next is a:
(A) Dendrite
(B) Node of Ranvier
(C) Sensory gap
(D) Synapse

120. Which feature distinguishes a motor neuron from a sensory neuron?
(A) A motor neuron transmits impulses away from the CNS to effectors.
(B) A motor neuron lacks an axon entirely and conducts only via dendrites.
(C) A motor neuron transmits sensory impulses from peripheral receptors to CNS.
(D) A motor neuron does not possess receptive

(B) Medulla
(C) Cerebellum
(D) Spinal cord

97. Which part of the brain ensures the precision of voluntary actions like picking up a pencil?
(A) Cerebrum
(B) Cerebellum
(C) Hypothalamus
(D) Medulla

98. The central role of the nervous system in animal behaviour is to:
(A) Process sensory input and dictate motor output
(B) Produce chemical energy directly from glucose molecules
(C) Store hereditary genetic information in cell nuclei
(D) Exchange respiratory gases with the external environment

99. Receptors for detecting smell are known as:
(A) Photoreceptors
(B) Thermoreceptors
(C) Olfactory receptors
(D) Gustatory receptors

100. Match List-I with List-II:
List I: (Brain Part)
P. Cerebrum
Q. Cerebellum
R. Medulla
S. Hypothalamus
List II: (Function)
1. Controls body temperature and hunger
2. Maintains posture and balance
3. Controls involuntary actions like heartbeat
4. Seat of intelligence and memory
(A) P-4, Q-2, R-3, S-1
(B) P-2, Q-4, R-1, S-3
(C) P-4, Q-3, R-2, S-1
(D) P-1, Q-2, R-3, S-4

101. A person touches a hot pan and immediately pulls their hand away. Which component acts as the effector in this scenario?
(A) The heat receptors in the skin
(B) The motor neuron
(C) The muscles of the arm
(D) The spinal cord

102. What differentiates an association neuron from a sensory neuron?
(A) An association neuron carries incoming sensory signals directly back to sense organs.
(B) An association neuron processes and relays signals within the central nervous system.
(C) An association neuron is located exclusively within peripheral sensory nerve trunks.
(D) An association neuron lacks a cell body and functions without chemical synapses.

103. If a patient suffers an injury to the cerebellum, what is the most likely symptom?
(A) Total loss of visual acuity and color perception
(B) Complete irreversible loss of stored long-term memory
(C) Sudden permanent stoppage of autonomic heartbeat
(D) Inability to maintain balance and coordinate walking

104. Which of the following nervous structures does NOT participate in a simple spinal reflex arc?
(A) Brain
(B) Sensory neuron
(C) Spinal cord
(D) Motor neuron

105. Consider the following statements about sense organs:
I. The tongue contains gustatory receptors.
II. The skin contains thermoreceptors.
III. The retina contains photoreceptors.
IV. The ear contains olfactory receptors.
Which combination of statements is correct?
(A) I, II, and III
(B) II, III, and IV
(C) I, III, and IV
(D) I, II, and IV

106. The part of the neuron where information is first acquired is the:
(A) Dendrite
(B) Axon
(C) Myelin sheath
(D) Synapse

107. At a synapse, the chemical messenger travels from the:
(A) Dendrite tip of one neuron directly to the axon of another
(B) Cell body cytoplasm of one neuron to the cell body of another
(C) Axon terminal of one neuron directly to the brainstem region
(D) Axon terminal of one neuron to the dendrite

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133. The sympathetic and parasympathetic nervous systems are parts of the:
(A) Central nervous system
(B) Somatic nervous system
(C) Autonomic nervous system
(D) Endocrine system

134. Which branch of the autonomic nervous system is most active when you are resting peacefully?
(A) Sympathetic nervous system
(B) Parasympathetic nervous system
(C) Somatic nervous system
(D) Motor nervous system

135. Consider the following statements about the autonomic nervous system:
I. The sympathetic nervous system increases the heart rate.
II. The parasympathetic nervous system slows down the heart rate.
III. Both systems are under direct voluntary control.
Which combination is correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II and III

136. Which of the following is an incorrect pair?
(A) Optic nerve - Carries auditory signals
(B) Retina - Primary site of image formation
(C) Cornea - Refraction of incoming light rays
(D) Iris - Regulates pupil size and aperture

137. The disorder in which electrical discharges in the brain become abnormal, causing convulsions, is called:
(A) Meningitis
(B) Paralysis
(C) Epilepsy
(D) Anemia

138. Which type of injury most commonly results in paralysis of the lower half of the body?
(A) Spinal cord injury
(B) Severe cut on the arm
(C) Damage to the eardrum
(D) Fracture of the skull

139. Damage to the spinal cord would most directly interfere with which of the following processes?
(A) Digestion of proteins
(B) Pumping of blood by the heart
(C) Gas exchange in the lungs
(D) Reflex actions of the legs

140. Match List-I with List-II:
List I: (Disorder/Condition)
P. Paralysis
Q. Epilepsy
R. Blindness
S. Deafness
List II: (Description)
1. Abnormal brain electrical activity
2. Loss of motor function
3. Damage to the auditory nerve
4. Damage to the optic nerve or retina
(A) P-2, Q-1, R-4, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-2, Q-1, R-3, S-4
(D) P-1, Q-2, R-4, S-3

141. The simplest form of nervous system, found in primitive animals like Hydra, consists of a:
(A) Well-developed brain
(B) Dorsal nerve cord
(C) Nerve net
(D) Ventral nerve cord

142. A stimulus is defined as:
(A) The physiological muscular reaction produced by a stimulated target organism
(B) The rapid electrical impulse travelling continuously along a myelinated axon
(C) A specific chemical hormone released directly by an endocrine gland into blood
(D) A detectable change in the internal or external environment

143. Which of the following represents the correct direction of nerve impulse conduction within a single neuron?
(A) Axon → Cell body → Dendrite
(B) Dendrite → Cell body → Axon
(C) Cell body → Axon → Dendrite
(D) Dendrite → Axon → Cell body

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144. The cranial nerves and spinal nerves together constitute the:
(A) Central Nervous System
(B) Peripheral Nervous System
(C) Endocrine System
(D) Circulatory System

145. Consider the following statements about the peripheral nervous system (PNS):
I. It connects the CNS to the limbs and organs.
II. It includes 12 pairs of cranial nerves in humans.
III. It includes 31 pairs of spinal nerves in

168. Defects in the embryonic formation of the nervous system can lead to severe congenital conditions such as:
(A) Spina bifida
(B) Scurvy
(C) Rickets
(D) Malaria

169. What ensures that the brain is not damaged by minor jolts to the head?
(A) A thick protective subcutaneous layer of adipose fat located outside skin tissue
(B) The natural biological softness and density of external scalp hair follicles
(C) Cerebrospinal fluid acting as a shock absorber inside the cranium
(D) The structural flexibility and elasticity of fused cranial skull bones in adults

170. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The transmission of a nerve impulse across a synapse is strictly unidirectional.
Reason (R): Neurotransmitters are released only from the axon terminals, and their receptors are located only on the dendrites of the next neuron.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

171. Which statement about the sympathetic nervous system is correct?
(A) It functions exclusively as part of the bony central nervous system structure.
(B) It primarily promotes digestive activities, nutrient absorption, and body rest.
(C) It operates strictly under conscious, voluntary control from the cerebral cortex.
(D) It prepares the body for stress and physical activity.

172. The rhythmic beating of the heart is an involuntary action controlled by the:
(A) Cerebrum
(B) Medulla
(C) Cerebellum
(D) Spinal cord

173. Which part of the brain allows you to solve a mathematical problem?
(A) Medulla
(B) Cerebellum
(C) Cerebrum
(D) Hypothalamus

174. In terms of animal coordination, how do sponges differ from higher animals like mammals?
(A) Sponges possess a highly developed centralized cranial brain for motor control.
(B) Sponges utilize a dorsal nerve spinal cord structure instead of a cranial brain.
(C) Sponges rely exclusively on an autonomic sympathetic division nervous system.
(D) Sponges lack true nervous tissue, unlike complex mammals.

175. When a bright light is shone into the eye, the receptor is the:
(A) Retina
(B) Iris
(C) Pupil
(D) Optic nerve

176. Which part of the eye determines the colour of a person's eyes?
(A) Cornea
(B) Iris
(C) Retina
(D) Lens

177. The optic nerve connects the eye to the:
(A) Spinal cord
(B) Cerebrum
(C) Cerebellum
(D) Medulla

178. What happens to the electrical signal once it reaches the brain from the optic nerve?
(A) The brain interprets signals to form visual images.
(B) The electrical signal is converted into an audible sound wave frequency.
(C) The brain reflects the unaltered impulse directly back to eye receptors.
(D) The signal undergoes chemical degradation and is destroyed immediately.

179. The tiny bones in the middle ear are the hammer, anvil, and:
(A) Pinna
(B) Cochlea
(C) Stirrup
(D) Tympanum

180. Match List-I with List-II:

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(C) Cerebellum
(D) Thalamus

156. In higher animals, complex behaviours are governed by the:
(A) Spinal cord
(B) Brain
(C) Peripheral nerves
(D) Autonomic ganglia

157. Which type of sensory receptor is most abundant in the skin?
(A) Light-sensitive retinal photoreceptors
(B) Taste-detecting gustatory receptors
(C) Tactile and thermoreceptors
(D) Odour-sensing olfactory receptors

158. The white appearance of the brain's "white matter" is due to the high concentration of:
(A) Cell bodies
(B) Dendrites
(C) Synapses
(D) Myelinated axons

159. The grey matter of the brain primarily consists of:
(A) Neuron cell bodies and unmyelinated fibres
(B) Tightly packed bundles of myelinated nerve axons
(C) Clear circulating cerebrospinal fluid within ventricles
(D) Dense networks of cerebral blood vessels and capillaries

160. Reflex arcs have evolved in animals because the thinking process of the brain:
(A) Is strictly dedicated to regulating digestive motility in intestines
(B) Is not fast enough to prevent injury in sudden situations
(C) Ceases to function completely during bright daytime activities
(D) Operates exclusively through slow release of circulatory hormones

161. A person who is completely paralyzed from the neck down has most likely suffered an injury to the:
(A) Lumbar region of the lower spinal cord
(B) Upper spinal cord (cervical region)
(C) Outer hemisphere of the posterior cerebellum
(D) Cranial segment of the peripheral optic nerve

162. Which sequence best represents the generation of a response to a stimulus?
(A) Effector → CNS → Receptor
(B) Receptor → CNS → Effector
(C) CNS → Receptor → Effector
(D) Receptor → Effector → CNS

163. The contraction of the pupil in bright light is an example of:
(A) A learned conditioned reflex response
(B) A conscious voluntary motor action
(C) An unconditioned reflex action
(D) A slow endocrine hormonal response

164. What happens to the ciliary muscles when the eye focuses on a nearby object?
(A) They completely relax, causing the crystalline lens to become much thinner
(B) They temporarily paralyze the muscular sphincter surrounding the iris pupil
(C) They generate inward mechanical tension that pushes the retina forward
(D) They contract and the lens becomes thicker (more convex)

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165. Choose the correct sequence of events when focusing on a distant object:
(A) Ciliary muscles contract → lens thickens → focal length decreases
(B) Ciliary muscles relax → lens becomes thinner → focal length increases
(C) Iris contracts → lens becomes thicker → focal length increases
(D) Cornea thickens → retina moves backward → focal length decreases

166. Sound waves entering the ear directly cause vibrations in which structure first?
(A) Fluid-filled inner ear cochlea
(B) Tympanic membrane (eardrum)
(C) Brain-bound auditory nerve
(D) Ossicular stirrup bone

167. Which of the following best explains why the nervous system is formed very early in embryonic development?
(A) It develops into the heaviest and largest functional organ system of the body
(B) It provides the sole metabolic source of cellular nutrition for the fetus
(C) It produces and continuously circulates protective amniotic fluid in utero
(D) It regulates and orchestrates the development of other body tissues

humans.
IV. It is completely protected by the skull and vertebral column.
Which combination is correct?
(A) I, II, and III
(B) I, II, and IV
(C) II, III, and IV
(D) I, III, and IV

146. Which part of the brain is crucial for maintaining posture and equilibrium during activities like riding a bicycle?
(A) Cerebellum
(B) Cerebrum
(C) Medulla
(D) Hypothalamus

147. How does acute mental stress generally affect the autonomic nervous system?
(A) It activates the parasympathetic division excessively throughout the entire body
(B) It completely shuts off both sympathetic and parasympathetic autonomic divisions
(C) It triggers the sympathetic division, increasing heart rate
(D) It exclusively alters the transmission speed of peripheral sensory neurons

148. Chronic mental stress over long periods can lead to:
(A) Dramatically improved cognitive function and memory
(B) Accelerated bone density growth and mineral deposition
(C) Enhanced digestive tract motility and nutrient absorption
(D) Nervous system fatigue and impaired coordination

149. The process from receiving a stimulus to producing a response relies entirely on the successful functioning of:
(A) The structural bone matrix of the skeletal system alone
(B) The gas exchange apparatus of the respiratory system alone
(C) The functional reflex arcs and neural pathways
(D) The muscular motility apparatus of the digestive tract

150. A patient has difficulty chewing and tasting food. Which nerves are most likely affected?
(A) Lumbar spinal nerves originating in the lower back region
(B) Cranial nerves associated with the face and mouth
(C) Autonomic nerves belonging to the sympathetic nervous system
(D) Peripheral motor nerves controlling skeletal muscles of legs

151. Which part of the nervous system is NOT directly involved in executing a reflex action when touching a hot object?
(A) Sensory neuron
(B) Spinal cord
(C) Motor neuron
(D) Cerebrum

152. In a reflex arc, where does the synapse between a sensory neuron and a motor neuron (or relay neuron) usually occur?
(A) Inside the spinal cord
(B) Inside the brain
(C) Inside the muscle
(D) Inside the sense organ

153. Why are synapses important in the nervous system?
(A) They continuously supply metabolic nutrients and energy to adjacent brain neurons.
(B) They physically shelter and insulate the neuronal cell body from mechanical damage.
(C) They ensure unidirectional impulse travel and allow information processing.
(D) They undergo rapid mitotic division to generate brand new replacement nerve cells.

154. What would happen if neurotransmitters were not cleared from the synapse after transmitting a signal?
(A) The next neuron would remain continuously stimulated
(B) The next postsynaptic neuron would never be stimulated again
(C) The electrical nerve impulse would immediately travel backward
(D) The synaptic cleft area would transform into a myelin sheath

155. Which structure is sometimes called the "relay center" or "switchboard" of the central nervous system, connecting sensory input to higher brain regions?
(A) Medulla
(B) Spinal cord

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List I: (Ear Part)
P. Pinna
Q. Tympanic membrane
R. Middle ear bones
S. Cochlea
List II: (Function)
1. Amplifies vibrations
2. Collects sound
3. Converts vibrations to electrical signals
4. Vibrates in response to sound waves
(A) P-2, Q-4, R-1, S-3
(B) P-4, Q-2, R-1, S-3
(C) P-2, Q-1, R-4, S-3
(D) P-1, Q-2, R-3, S-4

181. A loss of function in the auditory nerve would result in:
(A) Blindness
(B) Paralysis
(C) Deafness
(D) Loss of smell

182. A chemical substance that alters the normal functioning of synapses in the brain is often classified as a:
(A) Hormone
(B) Psychoactive drug
(C) Digestive enzyme
(D) Vitamin

183. Which of the following is considered an exception to the voluntary control rule?
(A) Picking up a glass of water
(B) Writing a letter
(C) Walking
(D) Blinking of the eyes

184. The coordination of the movement of the legs while walking is managed by the:
(A) Cerebellum
(B) Cerebrum
(C) Hypothalamus
(D) Medulla

185. Consider the following statements about neurotransmitters:
I. They are stored in small vesicles in the axon terminal.
II. They cross the synaptic cleft to bind to receptors on the next neuron.
III. They can either excite or inhibit the next neuron.
Which combination is correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II and III

186. Which cellular structure provides metabolic support for the neuron?
(A) Cell body (Cyton)
(B) Axon
(C) Synapse
(D) Myelin

187. What is the role of Schwann cells in the peripheral nervous system?
(A) They continuously secrete protective cerebrospinal fluid into ventricles
(B) They synthesize and release chemical neurotransmitters into synaptic gaps
(C) They store long-term cognitive memories within cerebral cortical networks
(D) They form the insulating myelin sheath surrounding peripheral axons

188. A person with an injured cerebellum might show which of the following signs?
(A) Sudden and immediate stopping of autonomic heartbeat
(B) Stumbling and uncoordinated walking posture
(C) Total and complete bilateral cortical blindness
(D) Complete inability to sense thermal or tactile pain

189. Nervous tissue cannot be found in which of the following body parts?
(A) Brain
(B) Spinal cord
(C) Hair
(D) Nerves

190. Consider the following statements about nervous tissue:
I. It is specialized to receive stimuli.
II. It is specialized to conduct electrical impulses.
III. It makes up the brain and spinal cord.
IV. It generates pulling forces to move bones.
Which combination of statements is correct?
(A) I, II, and III
(B) II, III, and IV
(C) I, III, and IV
(D) I, II, and IV

191. A sharp object piercing the skin directly triggers a response from the:

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(A) Pain receptors (nociceptors)
(B) Retinal photoreceptor cells
(C) Cutaneous thermoreceptor cells
(D) Nasal olfactory receptor cells

192. Which branch of biology primarily deals with the study of the nervous system?
(A) Cardiology
(B) Neurology
(C) Dermatology
(D) Hepatology

193. Epilepsy is best managed medically by controlling the:
(A) Strict nutritional dietary modifications and daily physical exercise routines
(B) Abnormal brain electrical discharges using specific anticonvulsant drugs
(C) Systemic arterial blood pressure through anti-hypertensive medication therapy
(D) Gastric acid secretion levels within the lining of the digestive stomach

194. The spinal cord passes through the protective bony rings of the vertebrae called the:
(A) Neural canal
(B) Cranial cavity
(C) Thoracic cavity
(D) Pelvic cavity

195. Arrange the following organisms in increasing order of nervous system complexity:
1. Human
2. Hydra
3. Earthworm
4. Sponge

(A) 4, 2, 3, 1
(B) 4, 3, 2, 1
(C) 2, 4, 3, 1
(D) 3, 2, 4, 1

196. How is the nervous system of an insect, like a cockroach, broadly structured compared to humans?
(A) It consists exclusively of a fused cranial brain with no spinal nerve cord.
(B) It features a hollow dorsal nerve cord coupled to a simple ventral brain.
(C) It lacks specialized neurons entirely and relies on fluid movement.
(D) It has a ventral nerve cord and simple cerebral ganglia.

197. Which of the following actions is completely involuntary and not governed by a reflex arc?
(A) Blinking when an object approaches the eye
(B) Pulling a hand away from fire
(C) Beating of the heart
(D) Knee-jerk response

198. The rapid conduction of impulses in humans allows for quick reflexes. What would happen if neurons lacked a myelin sheath?
(A) Electrical impulses would travel much faster across all neuronal axons
(B) Impulses would travel much slower, delaying bodily response times
(C) The brain tissue would overload from excess uninsulated electrical current
(D) Chemical neurotransmitters would no longer be needed for synaptic jump

199. The opposite of the "fight or flight" response is known as:
(A) Panic and anxiety
(B) Reflex withdrawal
(C) Synaptic delay
(D) Rest and digest

200. What is the most appropriate description of the brain's role in a reflex action?
(A) It receives sensory information after the reflex action has occurred.
(B) It actively initiates the rapid reflex motor response long before the spinal cord.
(C) It plays no physiological role at all, remaining entirely unaware of the reflex stimulus.
(D) It deliberate slows down the spinal reflex execution to prevent severe muscle damage.

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ANSWERS

1. (B) Nervous system
The nervous system is the main organ system in animals responsible for the rapid control and coordination of body activities. It detects stimuli from both internal and external environments, integrates sensory information, and sends fast electrical signals through specialized nerve cells to elicit immediate responses in target muscles, organs, and body tissues.

2. (A) Neuron
The neuron is the basic structural and functional unit of the nervous system. These highly specialized cells are designed to generate, conduct, and transmit nerve impulses across the body. Every complex neural pathway, reflex arc, and cognitive brain network relies on interconnected neurons to receive incoming information and coordinate appropriate physiological responses.

3. (C) Receiving stimuli and generating rapid responses
The primary function of the nervous system is to receive sensory stimuli from environmental changes and generate rapid responses to maintain stability. Receptors convert environmental energy into nerve impulses, which travel to central processing centers where appropriate motor instructions are formulated and dispatched to effectors like muscles or glands.

4. (D) Dendrite
Dendrites are branched, hair-like extensions arising from the cell body of a neuron. Their principal role is to receive incoming signals, stimuli, or chemical neurotransmitters from sensory receptors or neighboring nerve cells. Once acquired, dendrites conduct these incoming impulses toward the central cell body for processing and subsequent transmission along the axon.

5. (C) In the cell body
In a neuron, the nucleus is centrally located within the main cell body, also known as the cyton or soma. The cell body contains the cytoplasm, cellular organelles, and metabolic machinery necessary for maintaining neuronal health, synthesizing proteins, and supporting the metabolic demands required for transmitting signals along the axon.

6. (B) Axon
The axon is a single, long, cylindrical fibre extending from the neuronal cell body. Its major functional responsibility is to conduct nerve impulses away from the cyton toward other neurons, muscles, or secretory glands. Axons are often enveloped by protective insulating sheaths that increase the velocity of electrical impulse transmission.

7. (D) Transmitting the nerve impulse to the next neuron
The branched endings of an axon, known as axon terminals or telodendria, terminate near adjacent cells. When an electrical impulse reaches these terminal branches, it triggers the release of chemical neurotransmitters across the synaptic gap. This chemical release ensures the smooth transmission of the nerve impulse to the next neuron or effector.

8. (A) Sensory neuron
Sensory neurons, also termed afferent neurons, specialize in transmitting incoming nerve impulses from peripheral receptors and sense organs toward the central nervous system. They detect environmental changes such as light, temperature, sound, or pressure, converting these external stimuli into electrical signals that travel along afferent nerve pathways for central processing.

9. (C) To carry signals from the central nervous system to effectors
Motor neurons, or efferent neurons, carry nerve impulses away from the central nervous system to effector organs, such as muscles and glands. Upon receiving these central motor instructions, the target effectors contract or secrete substances, executing voluntary motor actions or involuntary physiological adjustments required for body regulation and survival.

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transmitted via the optic nerve to the visual cortex.

52. (D) Real and inverted
Light rays entering the eye are refracted by the curved cornea and convex crystalline lens, focusing directly onto the retina to form a real and inverted image. The brain's visual processing center subsequently interprets these inverted signals, turning the perceived image right side up during conscious visual experience.

53. (C) Rod cells
Rod cells are specialized photoreceptor cells in the retina sensitive to low levels of illumination. They contain the light-absorbing pigment rhodopsin, enabling twilight and night vision. Although rods cannot perceive colors or sharp details, they are crucial for detecting motion, shapes, and contrast under dim lighting conditions.

54. (B) Cone cells
Cone cells are specialized photoreceptors located within the retina that function under bright light conditions. They contain photopigments sensitive to specific wavelengths of light—red, green, and blue—allowing high-resolution visual acuity and full-color vision. Cones are concentrated densely in the central region of the retina called the fovea.

55. (A) I and II
The crystalline eye lens adjusts its curvature via ciliary muscles to fine-tune focal length, while the optic nerve transmits generated visual signals directly to the brain. However, the blind spot is completely devoid of rod and cone photoreceptors, making any statement claiming high photoreceptor concentration at that location false.

56. (A) It focuses light rays onto the retina.
The crystalline lens of the human eye is a transparent, flexible, biconvex structure situated behind the pupil. Its primary role is to fine-focus light rays reflected from objects onto the retinal surface, dynamically adjusting its focal length through ciliary muscle contractions to ensure sharp vision at various distances.

57. (C) Accommodation
Accommodation is the ability of the human eye lens to alter its focal length and curvature to focus clearly on objects at varying distances. Controlled by ciliary muscle contraction and relaxation, accommodation ensures that light rays from both near and far targets converge precisely onto the photosensitive retina.

58. (A) Optic nerve
The optic nerve is the sensory nerve bundle that connects the eye to the brain. It gathers electrical impulses generated by retinal photoreceptors—rods and cones—and transmits them directly to the visual cortex in the occipital lobe, where the brain integrates these signals into meaningful visual images.

59. (D) Iris
The iris is the visible, pigmented circular structure situated behind the cornea in the human eye. Containing melanin pigments that determine eye color, the iris functions as an adjustable muscular diaphragm, expanding or contracting to control pupil diameter and regulate the intensity of light entering the inner eye chamber.

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60. (A) P-3, Q-1, R-4, S-2
Each ocular structure performs a specific visual role: the transparent cornea serves as the protective outer entry surface, the muscular iris controls pupil diameter, the biconvex crystalline lens focuses light rays onto the inner eye wall, and the sensitive retina acts as the light-absorbing screen containing photoreceptor cells.

61. (C) Pinna
The pinna is the visible, cartilaginous outer portion of the human ear. Its funnel-like shape is specifically designed to collect acoustic sound waves from the surrounding environment and direct them into the auditory canal toward the tympanic membrane, initiating the physical sequence of hearing and acoustic signal processing.

62. (D) Eardrum
The tympanic membrane is commonly known as the eardrum. Situated at the terminus of the external auditory canal, this thin, cone-shaped tissue membrane separates the outer ear from the middle ear cavity, vibrating mechanically in direct response to pressure variations delivered by incoming airborne sound waves.

63. (A) It vibrates
When incoming sound waves traverse the external auditory canal and strike the flexible surface of the eardrum, they create rapid back-and-forth

20. (A) P-3, Q-4, R-2, S-1
Receptors are specialized sensory structures paired with specific sense organs to detect environmental changes. Photoreceptors in the eye perceive light signals, phonoreceptors in the ear detect sound vibrations, olfactory receptors in the nose sense airborne odor molecules, and gustatory receptors in the tongue process distinct taste chemicals during food consumption.

21. (D) Brain and spinal cord
The central nervous system in humans comprises the brain and the spinal cord. The brain acts as the primary integration and control center for thought, emotion, and organ regulation, while the spinal cord serves as a major pathway for transmitting sensory and motor signals and executing essential reflex actions.

22. (B) Nerves connecting the central nervous system to the body
The peripheral nervous system comprises all nerves located outside the brain and spinal cord, linking the central nervous system to the rest of the body. It includes cranial and spinal nerves that carry incoming sensory information from peripheral tissues and deliver motor commands to skeletal muscles, smooth muscles, and glands.

23. (C) Cranial nerves
Cranial nerves originate directly from the brain and exit through openings in the skull. In humans, twelve pairs of cranial nerves innervate structures primarily within the head, neck, and facial regions, carrying sensory input such as vision and smell while controlling motor functions including eye movements, facial expressions, and swallowing.

24. (D) Spinal nerves
Spinal nerves arise in pairs directly from the spinal cord, passing through spaces between adjacent vertebrae to distribute throughout the body. In humans, thirty-one pairs of spinal nerves convey sensory information from the limbs, trunk, and internal organs to the central nervous system and transmit motor commands back to effectors.

25. (B) I, II, and IV
The central nervous system includes the brain and spinal cord, while the peripheral nervous system connects this central network to body organs. Sensory nerves transport incoming signals from body tissues to the central processing centers. However, cranial nerves arise from the brain rather than the spinal cord, making that detail false.

26. (B) Reflex action
A reflex action is defined as a rapid, automatic, and involuntary response of the body to a specific external or internal stimulus. It occurs without conscious thought, relying on direct neural pathways to protect tissues from immediate physical harm or maintain essential internal body conditions without delaying for brain consideration.

27. (D) Reflex action
Rapidly withdrawing a hand after touching a hot surface is a classic example of a reflex action. Heat receptors in the skin generate impulses that travel along sensory neurons to the spinal cord, which immediately dispatches motor commands to arm muscles, pulling the hand away before pain is consciously processed.

28. (A) Spinal cord
The spinal cord serves as the primary control center for most simple reflex actions in the body. By processing incoming sensory inputs and generating immediate outgoing motor commands locally, the spinal cord circumvents the longer neural pathways to the brain, enabling instantaneous involuntary responses to potentially harmful environmental stimuli.

29. (C) Reflex arc
The complete neural pathway traversed by nerve impulses during a reflex action is called a reflex arc. It typically includes a sensory receptor, a sensory neuron, an integration center within the central nervous system, a motor neuron, and an effector organ such as a muscle or gland executing the response.

30. (A) Receptor
In a typical reflex arc, the receptor is the specialized sensory structure that detects environmental stimuli such as temperature, pressure, or light. Upon detecting a change, the receptor converts the physical or chemical energy into electrical signals, initiating nerve impulses along sensory neurons toward the central nervous system processing center.

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10. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Relay neurons, also called interneurons, reside entirely within the central nervous system, including the brain and spinal cord. Their specific anatomical location and functional architecture enable them to act as interconnecting bridges between incoming sensory neurons and outgoing motor neurons, thereby facilitating signal integration and complex reflex arc processing.

11. (D) Association neurons
Association neurons, or interneurons, are situated within the central nervous system to process incoming sensory information and formulate motor responses. They connect sensory and motor pathways, analyzing signals, storing memory, and facilitating decision-making processes. Their extensive synaptic connections enable complex integration required for higher cognitive functions and central coordination.

12. (B) Electrical signal
A nerve impulse travels through a neuron in the form of a rapid electrical signal, known as an action potential. This electrical signal is generated by temporary alterations in ionic movement across the neuronal cell membrane. It moves rapidly along the dendrites, cell body, and axon to ensure swift signal transmission.

13. (C) A physical or chemical stimulus
The generation of a nerve impulse in a sensory receptor requires a physical or chemical stimulus from the internal or external environment. When light, sound, heat, or chemical molecules interact with specialized receptor cells, they alter membrane permeability, triggering an electrical depolarization that initiates a nerve impulse along sensory neurons.

14. (D) Chemicals called neurotransmitters are released
When an electrical nerve impulse reaches the terminal end of an axon, it cannot cross the physical fluid-filled gap of the synapse electronically. Instead, the electrical arrival stimulates tiny synaptic vesicles to release chemical signaling molecules called neurotransmitters. These chemicals diffuse across the gap to excite the adjacent neuron.

15. (A) I and II
Sensory information is initially acquired at the specialized dendritic tips of nerve cells. The resulting electrical impulse travels through the dendrite into the cell body and moves onward down the axon. However, at the axon terminal, the electrical signal converted into chemical neurotransmitters rather than entering directly without chemical changes.

16. (B) Synapse
A synapse is the microscopic functional junction or gap existing between the terminal axon branch of one neuron and the dendrite or cell body of an adjacent neuron. It serves as a selective communication gateway where electrical signals are converted into chemical messengers, ensuring controlled and directed impulse transmission.

17. (B) Diffusion of chemical neurotransmitters
The transfer of a nerve signal across the narrow synaptic cleft is mediated by the diffusion of chemical neurotransmitters. Upon arrival of an action potential at the presynaptic terminal, neurotransmitter molecules are secreted, crossing the intercellular space to bind specific receptors on the postsynaptic membrane, thus propagating the neural signal.

18. (A) Because neurotransmitters are released only at axon terminals
Impulse transmission across a synapse is strictly unidirectional because chemical neurotransmitter vesicles are stored and released exclusively from presynaptic axon terminals. Corresponding neurotransmitter receptors are located only on postsynaptic dendrites or cell bodies. Consequently, signals can move in only one direction across the synaptic cleft throughout the nervous system.

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19. (C) A chemical messenger that crosses the synaptic gap
A neurotransmitter is a specialized chemical messenger synthesized by nerve cells to transmit signals across the microscopic synaptic gap. When released from presynaptic axon vesicles into the synaptic cleft, it binds specifically to target receptors on the adjacent postsynaptic neuron, muscle cell, or gland to pass the neural message.

41. (C) Parasympathetic nervous system
The parasympathetic nervous system restores the body to a state of calm following stress, functioning as the rest-and-digest mechanism. It conserves metabolic energy by reducing heart rate, lowering blood pressure, stimulating digestive enzyme secretion, and promoting intestinal motility to facilitate efficient nutrient absorption and internal physiological maintenance.

42. (A) It stimulates and promotes digestion
The parasympathetic nervous system actively promotes digestive processes during restful states. It stimulates salivary gland secretion, enhances gastric juice production, increases smooth muscle peristalsis along the digestive tract, and relaxes intestinal sphincters, ensuring that ingested food is efficiently broken down, moved along, and absorbed into the bloodstream.

43. (D) Detect specific stimuli from the environment
Sense organs are specialized biological structures engineered to detect specific stimuli from both internal and external environments. Containing specialized sensory receptor cells, these organs absorb physical or chemical cues—such as light, sound, taste, or thermal changes—and transform them into electrical impulses for interpretation by the central nervous system.

44. (B) Liver
The human body utilizes five primary sense organs to perceive external surroundings: the eyes, ears, nose, tongue, and skin. In contrast, the liver is an internal metabolic organ responsible for biochemical processing, toxin detoxification, and bile secretion, lacking specialized sensory receptors designed for external environmental detection.

45. (A) 2, 1, 4, 3
Sensory perception begins when a receptor detects an environmental stimulus. Next, a sensory neuron transmits the generated electrical impulse along afferent nerve fibers. The impulse then reaches the central nervous system via the spinal pathways, where the brain interprets the signal to formulate a conscious sensory experience.

46. (D) Skin
The skin is the primary sense organ responsible for detecting thermal changes in the environment. It contains specialized thermoreceptor nerve endings sensitive to hot and cold temperatures. Upon stimulation, these receptors convert thermal energy into nerve signals sent to the brain, enabling appropriate thermoregulatory and behavioral responses.

47. (A) Olfactory receptors
The nasal cavity contains specialized olfactory receptors embedded within the olfactory epithelium. These chemoreceptors bind volatile airborne chemical molecules, generating electrical impulses that travel along the olfactory nerve directly to the brain, allowing organisms to detect, distinguish, and interpret a vast array of environmental odors and scents.

48. (B) Tongue
Gustatory receptors are specialized chemoreceptors primarily located within taste buds on the surface of the tongue. They detect dissolved chemical substances from food, converting chemical stimuli into electrical nerve signals that travel to the brain, allowing the perception of basic taste modalities such as sweet, sour, salty, bitter, and umami.

49. (B) Cornea
The cornea is the transparent, curved front covering of the human eye that allows light rays to enter the ocular interior. It acts as the eye's primary refractive surface, bending incoming light significantly toward the crystalline lens to ensure proper light focusing onto the photosensitive retina at the back.

50. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
The pupil dynamically alters its diameter based on ambient light levels. The iris, a pigmented muscular diaphragm surrounding the pupil, contracts or relaxes its smooth muscle fibers to regulate pupil size, controlling the quantity of light reaching the retina and protecting delicate photoreceptors from excessive or inadequate illumination.

51. (C) Retina
The retina is the innermost, light-sensitive layer of the human eye, functioning as an internal screen where visual images form. It contains millions of photoreceptor cells—rods and cones—that convert focused light patterns into electrical neural impulses, which are subsequently

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74. (A) Cerebrospinal fluid
Cerebrospinal fluid is a clear, colorless liquid circulating within the brain ventricles, central canal of the spinal cord, and subarachnoid spaces. It acts as a protective fluid cushion, absorbing mechanical impacts, protecting delicate neural tissues from physical shocks, providing buoyancy, and facilitating metabolic nutrient exchange and waste removal.

75. (D) Reflex actions below the neck
The spinal cord serves as the primary integrating center for controlling simple reflex actions occurring below the neck. By processing incoming sensory inputs locally and instantly dispatching outgoing motor commands to peripheral effectors, the spinal cord allows rapid, protective muscular responses without requiring immediate higher brain cognitive intervention.

76. (B) Reflex arcs and voluntary movements in affected limbs
Injury to the spinal cord disrupts nerve pathways connecting the brain and peripheral nervous system. This damage impairs or completely blocks incoming sensory feedback and outgoing motor commands below the injury level, leading to the loss of spinal reflex arcs and impaired voluntary muscular movement in affected body limbs.

77. (C) Loss of muscle function and voluntary movement due to nerve damage
Paralysis refers to the loss of voluntary muscle control and motor function resulting from structural or functional damage to the nervous system. When injuries disrupt spinal pathways, cranial nerves, or brain motor areas, electrical signals cannot reach target skeletal muscles, preventing voluntary movement in the affected body parts.

78. (D) Epilepsy
Epilepsy is a chronic neurological disorder characterized by recurrent, unprovoked seizures. These epileptic episodes stem from abnormal, excessive, and hypersynchronous electrical discharges originating within cortical brain neurons, leading to temporary disturbances in motor control, sensory perception, behavior, or state of consciousness during affected clinical episodes.

79. (A) Sudden, disorganized bursts of electrical nerve impulses occur
During an epileptic seizure, neurons within specific regions or across the entire brain experience sudden, disorganized bursts of high-frequency electrical impulses. This abnormal electrical hyper-synchrony disrupts normal neuronal signaling pathways, leading to involuntary muscular contractions, physical convulsions, sensory distortions, or temporary loss of conscious awareness.

80. (B) Neurons (nerve cells)
Nervous tissue is composed primarily of highly specialized cells called neurons, along with supporting neuroglial cells. Neurons are uniquely adapted to generate, receive, process, and propagate electrical signals rapidly throughout the organism, serving as the core structural and functional elements of both central and peripheral nervous system networks.

81. (B) Myelin sheath
The myelin sheath is a lipid-rich insulating layer wrapping around neuronal axons. Formed by glial cells, it significantly increases the speed of nerve impulse propagation by preventing electrical current leakage and facilitating saltatory conduction, allowing action potentials to jump rapidly between uninsulated gaps called nodes of Ranvier.

82. (A) To act as an electrical insulator and increase impulse speed
The primary function of the myelin sheath is to serve as an electrical insulator surrounding the axon. By preventing ion leakage across the axonal membrane, myelin allows electrical impulses to jump rapidly from node to node, dramatically accelerating the conduction velocity of action potentials along myelinated nerve fibers.

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83. (C) Nodes of Ranvier
Nodes of Ranvier are the periodic uninsulated gaps along a myelinated axon where the axonal membrane is exposed. These unmyelinated intervals contain high concentrations of voltage-gated ion channels, enabling saltatory conduction as electrical action potentials jump rapidly from node to node, substantially increasing signal transmission speed.

mechanical vibrations. These vibrations mirror the frequency and amplitude of the sound waves, transferring mechanical kinetic energy to the three small ossicles of the middle ear.

64. (B) Amplify vibrations received from the eardrum
The middle ear contains three tiny bones: the malleus, incus, and stapes, commonly called the hammer, anvil, and stirrup. These ossicles form a mechanical lever system that amplifies acoustic vibrations transmitted from the eardrum, efficiently transferring amplified sound energy into the fluid-filled cochlea within the inner ear.

65. (A) I, II, and III
The outer ear features the pinna, while the middle ear houses the hammer, anvil, and stirrup bones. The inner ear contains the fluid-filled cochlea. However, the auditory nerve carries acoustic signals rather than visual signals to the brain, making the fourth statement factually incorrect regarding auditory pathway function.

66. (A) Cochlea
The cochlea is a coiled, snail-shell-like fluid-filled organ located in the inner ear. It contains specialized hair cells within the organ of Corti that detect mechanical pressure waves in the inner ear fluid, converting these physical vibrations into electrical neural signals transmitted to the auditory processing centers of the brain.

67. (C) Auditory nerve
The auditory nerve, also known as the cochlear nerve, is responsible for transmitting electrical signals generated by sensory hair cells in the cochlea to the auditory cortex of the brain. The brain processes these electrical signals, enabling the conscious perception, differentiation, and interpretation of various sound frequencies and volumes.

68. (D) Maintaining body balance and posture
Beyond its essential role in hearing, the inner ear houses the vestibular apparatus, which includes the semicircular canals and otolith organs. These specialized structures detect gravitational forces, angular movements, and head position, sending continuous positioning signals to the brain to maintain dynamic equilibrium, body posture, and motor balance.

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69. (C) Because the nervous system cannot reach every single cell in the body
Coordination between the nervous and endocrine systems is essential because direct nerve innervations do not reach every individual cell in the body. While the nervous system provides rapid, localized electrical messaging to specific tissues, chemical hormones secreted into blood vessels diffuse widely, regulating long-term metabolic cellular processes universally.

70. (B) The endocrine system relies on chemical messengers in the blood, which is slower than nerve impulses.
The endocrine system differs from the nervous system by utilizing chemical hormones transported through the bloodstream rather than rapid electrical action potentials along nerve fibers. Consequently, endocrine responses develop more slowly and persist over longer durations, whereas neural signals provide immediate, localized, and short-lived electrical communication to target tissues.

71. (D) Nervous and endocrine systems
When an animal encounters a life-threatening danger, the nervous and endocrine systems operate in tight coordination to prepare the body for survival. Neural pathways rapidly activate the sympathetic system, while the adrenal glands release adrenaline into the bloodstream, elevating heart rate, respiration, and muscle alertness for fight-or-flight responses.

72. (A) Vertebral column
The vertebral column, commonly called the spine or backbone, serves as a protective bony structure surrounding the delicate spinal cord. Made up of individual articulated vertebrae forming a hollow neural canal, it shields spinal nerve pathways from mechanical impacts, twisting injuries, and external physical trauma during movement.

73. (C) Medulla
The spinal cord is a continuous cylindrical bundle of nerve tissue extending downward from the medulla oblongata, the lowermost part of the hindbrain. Exiting the skull through the foramen magnum, the spinal cord traverses the neural canal, linking brain motor centers with peripheral nerves throughout the body trunk.

31. (D) Motor neuron
Within a reflex arc, the motor neuron carries the outgoing electrical signal away from the central nervous system toward an effector, such as a muscle or gland. Upon receiving this electrical impulse, the effector executes the required protective or corrective movement, completing the automated reflex loop swiftly and efficiently.

32. (B) The biceps muscle of the arm
When withdrawing a hand from a sharp pin, the effector organ is the biceps muscle of the arm. Pain receptors send signals via sensory neurons to the spinal cord, which dispatches motor impulses directly to the biceps muscle, causing it to contract rapidly and pull the hand away from danger.

33. (C) They protect the body from harm through rapid responses
Reflex actions are vital for animal survival because they provide rapid, involuntary responses to dangerous stimuli without requiring time-consuming brain processing. By bypassing conscious cognitive thought, reflex arcs trigger immediate defensive movements, minimizing physical injury, tissue damage, or physiological strain when an organism encounters environmental hazards or sudden trauma.

34. (D) It relies on the brain for executing simple withdrawal responses.
A reflex arc relies primarily on sensory and motor neurons coordinated through the spinal cord to execute extremely fast, involuntary responses via specific effector organs. It does not depend on conscious cerebral thinking or brain intervention to carry out simple withdrawal reflexes, ensuring immediate protection against potentially dangerous environmental threats.

35. (B) Receptor → Sensory neuron → Spinal cord → Motor neuron → Effector
The correct functional sequence of a reflex arc begins when a receptor detects a stimulus. A sensory neuron transmits the resulting signal to the spinal cord, where integration occurs. A motor neuron then carries the outgoing instruction directly to an effector, such as a muscle, producing an immediate physical response.

36. (B) Involuntary actions like heartbeat and digestion
The autonomic nervous system is a specialized peripheral division that regulates involuntary biological functions without conscious effort. It continually monitors and controls visceral organ activities, including cardiac muscle contraction, smooth muscle motility in digestive tracts, glandular secretions, and pupil constriction to maintain homeostatic internal balance throughout daily activities.

37. (C) Sympathetic and parasympathetic systems
The autonomic nervous system comprises two distinct functional divisions: the sympathetic nervous system and the parasympathetic nervous system. Together, these complementary pathways innervate internal visceral organs, smooth muscles, and glands to dynamically regulate body functions, balancing high-energy emergency reactions with energy-conserving resting activities according to metabolic needs.

38. (D) They have antagonistic (opposite) effects on most internal organs.
The sympathetic and parasympathetic divisions of the autonomic nervous system generally exert antagonistic effects on internal organs. While the sympathetic branch prepares the body for action by elevating heart rate and metabolic activity, the parasympathetic branch promotes rest and digestion by slowing cardiac rhythm and enhancing nutrient processing.

39. (A) Sympathetic nervous system
During fight-or-flight emergency situations, the sympathetic nervous system becomes dominant. It rapidly mobilizes physiological resources by accelerating heart rate, dilating bronchial airways, elevating blood pressure, and increasing glucose release. These immediate internal adjustments prepare the animal to either confront the impending danger or flee from potential physical harm effectively.

40. (A) Increasing the heart rate
Activation of the sympathetic nervous system increases the heart rate to enhance blood circulation during physical exertion or acute stress. This physiological adjustment ensures that oxygenated blood and essential nutrients are rapidly delivered to skeletal muscles and vital organs, enabling the body to cope effectively with emergency demands.

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84. (D) It is very rapid, allowing for immediate bodily responses
Nerve impulse conduction is exceptionally rapid, traveling at speeds up to one hundred meters per second in heavily myelinated axons. This rapid velocity enables the central nervous system to receive sensory input, process environmental changes, and dispatch motor instructions almost instantaneously, ensuring immediate physiological and behavioral responses.

85. (B) Cornea → Pupil → Lens → Retina
Light entering the human eye follows a specific sequential pathway. It first passes through the transparent cornea, then traverses the open pupil surrounded by the iris, moves through the flexible biconvex crystalline lens for fine refraction, and finally converges onto the photosensitive retina at the back wall.

86. (B) The refractory period of the membrane prevents backward conduction
A single nerve impulse cannot travel backward along an axon due to the absolute refractory period of the cell membrane. Following depolarization, sodium channels temporarily close and enter an inactive state, preventing the recently activated membrane segment from generating another action potential and ensuring strictly forward impulse propagation.

87. (D) Ectoderm
During early embryonic development, the entire nervous system originates from the ectoderm, the outermost primary germ layer. Through a specialized developmental process called neurulation, a region of the ectoderm thickens to form the neural plate, which subsequently folds to form the neural tube, giving rise to the brain and spinal cord.

88. (A) Because it coordinates the development and function of organ systems
Proper neural development during embryonic growth is critical because the nervous system serves as the master regulatory network that coordinates organogenesis, tissue differentiation, and systemic physiological functions. Early neural signals guide structural organization, muscular innervation, and homeostatic integration required for the ultimate survival of the developing organism.

89. (C) Acetylcholine
Acetylcholine is a major neurotransmitter chemical operating throughout the central and peripheral nervous systems. Released from presynaptic axon terminals, acetylcholine diffuses across synaptic clefts and neuromuscular junctions, binding specific receptors to facilitate nerve signal transmission, stimulate skeletal muscle contractions, and regulate parasympathetic autonomic activity.

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90. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Myelinated nerve fibers conduct action potentials significantly faster than non-myelinated fibers. The myelin sheath acts as a high-resistance electrical insulator, preventing charge leakage across the axon membrane and forcing the electrical signal to jump rapidly from one uninsulated node of Ranvier to the next via saltatory conduction.

91. (D) Impaired memory, fatigue, and poor coordination
Severe mental stress negatively impacts the nervous system by triggering sustained high levels of stress hormones like cortisol. Over time, elevated cortisol levels disrupt neuronal synaptic plasticity, impair memory consolidation in the hippocampus, cause persistent systemic fatigue, and diminish motor coordination and overall executive cognitive functioning.

92. (B) Cranium
The human brain is encased and protected within a rigid bony structure known as the cranium, or skull. Composed of fused cranial bones, the cranium provides a robust physical shield that protects delicate brain tissues and central neural centers from external mechanical forces, impact trauma, and environmental injury.

93. (C) Cerebrum (Forebrain)
The cerebrum, forming the largest portion of the forebrain, is recognized as the main thinking part of the human brain. It contains specialized cortical regions responsible for complex cognitive activities, including abstract reasoning, voluntary motor planning, sensory perception, language comprehension, problem-solving, emotional regulation, and long-term memory storage.

of the cerebral cortex for detailed cognitive processing.

156. (B) Brain
In higher animals, complex behaviors such as social interaction, cognitive learning, problem-solving, and emotional responses are governed by the brain. The brain integrates diverse sensory inputs, compares them with stored memories, and formulates coordinated, highly adaptive behavioral patterns executed through complex neural pathways and precise fine motor control.

157. (C) Tactile and thermoreceptors
The skin contains an abundance of tactile receptors and thermoreceptors. Tactile mechanoreceptors sense touch, pressure, and vibration, while thermoreceptors detect temperature variations. Together with pain-sensing nociceptors, these specialized cutaneous receptors continuously monitor environmental interactions, sending sensory signals to the brain to ensure physical protection and thermal regulation.

158. (D) Myelinated axons
The white matter of the central nervous system derives its characteristic pale appearance from a dense concentration of myelinated nerve axons. High lipid content within the myelin sheaths surrounding these axonal tracts acts as biological insulation, facilitating high-speed transmission of electrical impulses between different functional regions of the brain.

159. (A) Neuron cell bodies and unmyelinated fibres
The grey matter of the brain primarily consists of neuron cell bodies, dendrites, unmyelinated axonal fibers, synapses, and supporting neuroglial cells. Lacking significant myelin insulation, grey matter serves as the primary tissue for active information processing, neural integration, sensory perception, decision-making, and memory storage within the cerebral cortex.

160. (B) Is not fast enough to prevent injury in sudden situations
Reflex arcs evolved in animals because conscious cerebral processing is too slow to protect the body during sudden hazardous events. Bypassing complex brain thought pathways, spinal reflex arcs route sensory inputs directly to motor neurons, triggering instantaneous defensive movements that prevent or minimize severe tissue injury from dangerous stimuli.

161. (B) Upper spinal cord (cervical region)
A person suffering complete paralysis from the neck down has sustained severe injury to the upper cervical region of the spinal cord. Damaging spinal nerve pathways high in the neck severs communication between the brain motor centers and skeletal muscles throughout the lower body and limbs, causing quadriplegia.

162. (B) Receptor → CNS → Effector
The standard physiological sequence in generating a response to an environmental stimulus begins when a receptor detects a physical or chemical change. A sensory neuron conveys the signal to the central nervous system for integration, which then dispatches motor commands along efferent pathways to an effector to produce an action.

163. (C) An unconditioned reflex action
Contraction of the pupil in bright light is a classic example of an unconditioned, inborn reflex action. Triggered automatically without prior learning or conscious thought, optic sensory signals enter the brainstem, which dispatches immediate autonomic parasympathetic commands to iris sphincter muscles, constricting the pupil to protect the retina.

164. (D) They contract and the lens becomes thicker (more convex)
When focusing on a nearby object, ciliary muscles inside the eye contract, relaxing tension on the suspensory ligaments. This reduction in tension allows the elastic crystalline lens to round up, becoming thicker and more convex. This structural change increases the lens's refractive power, focusing divergent light rays onto the retina.

165. (B) Ciliary muscles relax → lens becomes thinner → focal length increases
When focusing on a distant object, ciliary muscles relax, increasing tension on the suspensory ligaments attached to the eye lens. This outward pull flattens the crystalline lens, making it thinner and increasing its focal length, allowing parallel incoming light rays to focus sharply onto the light-sensitive retinal layer.

166. (B) Tympanic membrane (eardrum)
Sound waves entering the external auditory canal strike the tympanic membrane first, causing it to vibrate mechanically. These acoustic vibrations match the frequency and intensity of

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104. (A) Brain
The brain does not directly participate in executing a simple spinal reflex arc. Simple reflexes, such as withdrawing a hand from pain, are integrated locally within the spinal cord through direct pathways involving sensory neurons, relay interneurons, and motor neurons, allowing immediate muscular action without waiting for brain processing.

105. (A) I, II, and III
The tongue features specialized gustatory receptors for taste, the skin contains thermoreceptors for temperature detection, and the retina houses photoreceptors for vision. However, the human ear contains phonoreceptors for sound and vestibular receptors for balance rather than olfactory receptors, making the fourth statement factually incorrect regarding sensory organ anatomy.

106. (A) Dendrite
The dendrite is the specialized receptive region of a neuron where sensory information or chemical signals are first acquired. Featuring fine branched structures, dendrites collect incoming environmental stimuli or neurotransmitter signals from adjacent cells, converting them into electrical impulses that travel toward the cell body for onward processing.

107. (D) Axon terminal of one neuron to the dendrite of another
At a chemical synapse, signal transmission occurs as chemical neurotransmitters diffuse across the microscopic gap from the presynaptic axon terminal of one neuron to the postsynaptic dendrite or cell body of another neuron. This specific pathway ensures controlled, unidirectional communication between interconnected nerve cells within the nervous system.

108. (B) Myelin sheath
A non-myelinated neuron completely lacks a myelin sheath surrounding its axon. While it retains all standard structural elements—including the cell body, nucleus, dendrites, and axon—the absence of insulating myelin layers means impulse conduction occurs continuously along the axonal membrane at a slower speed than in myelinated fibers.

109. (C) Reflex action
An involuntary, rapid response to a stimulus that occurs without initial conscious involvement of the brain is called a reflex action. Processed primarily through neural circuits in the spinal cord, reflex actions allow instantaneous motor responses to potentially harmful events, protecting tissue integrity before conscious brain awareness occurs.

110. (D) The spot on the retina where the optic nerve exits lacking photoreceptors
The blind spot is the specific site on the posterior retina where optic nerve fibers converge and exit the eyeball toward the brain. Because this exit region contains no photoreceptor cells—neither rods nor cones—light focused directly onto this exact spot cannot be converted into nerve signals, creating an unperceived visual area.

111. (A) It acts as an aperture allowing light to enter
The pupil is the central aperture in the eye's iris that allows light rays to enter the internal ocular chamber. By adjusting its diameter through smooth muscle contraction and relaxation in the surrounding iris, the pupil regulates the precise intensity of light reaching the crystalline lens and light-sensitive retina.

112. (B) The absorption of light rays entering it without reflection back
The pupil appears black because light rays passing through this aperture enter the dark interior of the eye and are almost entirely absorbed by the pigmented choroid layer and retina. Since virtually no light reflects back out through the pupil, the opening appears completely black to an outside observer.

113. (B) Dilates to allow more light to enter
In dim light conditions, the pupil dilates, expanding its central aperture to maximize the amount of light entering the eye. Smooth radial muscles in the iris contract, pulling the pupil open, which enhances light collection onto the sensitive rod cells of the retina, improving visual perception under low illumination.

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114. (A) Cartilage
The pinna, or external outer ear flap, is primarily composed of elastic cartilage covered by a thin layer of skin. This flexible cartilaginous framework gives the pinna its distinct funnel shape, allowing it to collect incoming environmental sound waves

94. (D) Voluntary actions, memory, and cognitive learning
The cerebrum serves as the central hub for higher brain functions, governing conscious voluntary motor actions, memory encoding, and cognitive learning. Its extensive cortical network integrates incoming sensory information, facilitating complex analytical thinking, decision-making, creativity, speech, and deliberate physical movements tailored to internal goals and environmental cues.

95. (A) I and II
The hindbrain consists of the cerebellum, pons, and medulla oblongata, with the cerebellum maintaining body posture, balance, and motor coordination. However, the medulla controls crucial involuntary visceral reflexes such as respiration and heart rate, whereas voluntary movements like writing are governed by the cerebral cortex, making statement III false.

96. (B) Medulla
The medulla oblongata, situated within the human hindbrain, houses vital autonomic reflex centers that automatically control essential involuntary bodily functions. It regulates systemic blood pressure through vasomotor pathways, manages cardiac rhythms, controls fundamental respiratory patterns, and coordinates necessary involuntary reflex actions such as salivation, swallowing, coughing, and vomiting.

97. (B) Cerebellum
The cerebellum, located at the posterior base of the brain, ensures the precision and smooth execution of voluntary muscular movements, such as picking up a pencil. It processes sensory feedback from muscles and joints, continuously fine-tuning motor outputs to maintain body balance, spatial posture, and fine motor dexterity.

98. (A) Process sensory input and dictate motor output
The fundamental role of the nervous system in animal behavior is to process incoming sensory input from internal and external environments and dictate appropriate motor output. By receiving, integrating, and interpreting environmental signals, the nervous system enables animals to execute adaptive physical behaviors, escape threats, and seek resources.

99. (C) Olfactory receptors
Olfactory receptors are specialized chemical receptors located within the nasal mucous membrane that detect odor molecules. When volatile chemical airborne compounds dissolve in the nasal mucus and bind these receptors, electrical impulses are generated and transmitted along the olfactory nerve to the brain for smell perception and identification.

100. (A) P-4, Q-2, R-3, S-1
The human brain parts perform distinct functional roles: the cerebrum serves as the primary seat of intelligence and conscious thought, the cerebellum coordinates body balance and posture, the medulla oblongata controls vital involuntary actions like heartbeat, and the hypothalamus regulates fundamental homeostatic drives including body temperature and hunger.

101. (C) The muscles of the arm
When a person touches a hot pan and rapidly pulls their hand away, the muscles of the arm act as the effector. Sensory neurons detect heat and send signals to the spinal cord, which dispatches motor commands directly to arm muscles, stimulating muscular contraction to pull the hand away.

102. (B) An association neuron processes and relays signals within the central nervous system.
An association neuron, or interneuron, differs from a sensory neuron by operating exclusively within the central nervous system. While sensory neurons transmit incoming signals from peripheral receptors, association neurons integrate, analyze, and process these inputs before relaying appropriate commands to motor neurons, enabling complex reflex arc processing and cognition.

103. (D) Inability to maintain balance and coordinate walking
Injury to the cerebellum severely impairs motor control, leading to an inability to maintain balance, posture, and coordinated walking. Because the cerebellum fine-tunes voluntary muscular movements based on sensory feedback, cerebellar damage results in uncoordinated movements, tremors, unsteady gait, and loss of physical equilibrium without causing total paralysis.

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125. (C) Is covered by an insulating myelin sheath
The speed of a nerve impulse increases significantly when an axon is enclosed within a myelin sheath. Myelin acts as an electrical insulator that prevents current leakage across the axonal membrane, enabling rapid saltatory conduction where action potentials jump sequentially from one node of Ranvier to another down the fiber.

126. (D) Nervous tissue
Nervous tissue is uniquely specialized to receive biological or environmental stimuli, convert them into electrical signals, and transmit these impulses rapidly throughout the organism. Composed of interconnected neurons and supporting neuroglial cells, nervous tissue forms the brain, spinal cord, and peripheral nerves, coordinating rapid physiological control and integrated bodily communication.

127. (A) Spinal cord
The peripheral nervous system consists of neural structures located outside the central nervous system, including cranial nerves, spinal nerves, and sensory nerve fibers. In contrast, the spinal cord—along with the brain—forms the central nervous system, functioning as the central integrating and command processing hub of the body.

128. (B) Because nerve impulses cannot reach every cell, while blood hormones diffuse widely
Although the nervous system provides high-speed electrical control, nerve fibers do not directly innervate every single cell in the body. The endocrine system complements neural regulation by releasing hormones into the bloodstream, allowing chemical signals to diffuse widely and regulate widespread metabolic growth, cellular development, and homeostatic processes everywhere.

129. (B) By rearranging specialized muscle proteins inside the cell
Animal muscle cells change their shape in response to a nerve impulse by rearranging specialized intracellular muscle proteins, specifically actin and myosin filaments. When an incoming motor nerve impulse triggers calcium ion release within the muscle cell, these protein filaments slide past one another, causing cellular contraction and movement.

130. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
The nervous and endocrine systems operate in coordination to regulate body functions effectively. The nervous system delivers rapid, precise, but short-lived electrical control for immediate reactions, whereas the endocrine system secretes blood-borne chemical hormones providing slower, widespread, and long-lasting physiological regulation, ensuring comprehensive control across all tissues.

131. (C) Brain
The brain serves as the primary integrating center of the body. It receives incoming sensory signals from all body parts, processes and interprets complex environmental data, stores information as memory, formulates decision pathways, and coordinates outgoing motor instructions to maintain homeostatic regulation, complex movements, and adaptive physiological actions.

132. (D) A nerve
A nerve is defined as a macroscopic bundle of individual nerve fibers enclosed within a protective tubular sheath of connective tissue. Located in the peripheral nervous system, nerves conduct electrical impulses between the central nervous system and sensory organs, skeletal muscles, internal visceral organs, and bodily tissues throughout the frame.

133. (C) Autonomic nervous system
The sympathetic and parasympathetic nervous systems are the two primary divisions of the autonomic nervous system. Operating involuntarily, these twin subdivisions innervate internal visceral organs, smooth muscles, cardiac tissues, and exocrine glands, acting antagonistically to dynamically balance energy expenditure, emergency readiness, and energy-conserving vegetative internal processes.

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134. (B) Parasympathetic nervous system
The parasympathetic nervous system is most active during periods of quiet rest and relaxation. Often termed the rest-and-digest division, it slows cardiac output, reduces arterial blood pressure, promotes gastrointestinal motility and digestion, and conserves metabolic energy, maintaining internal homeostatic stability and promoting long-term cellular recovery and growth.

efficiently while maintaining structural flexibility and resisting physical damage.

115. (A) 2, 1, 4, 3
Sound waves traverse the human ear in a precise structural sequence. External sound waves are collected by the outer pinna, travel through the ear canal to vibrate the eardrum, are amplified through the middle ear ossicles, and finally reach the fluid-filled cochlea, where mechanical energy is converted into neural signals.

116. (D) Autonomic nervous system
The contraction of heart muscle is regulated continuously by the autonomic nervous system. Operating involuntarily without conscious oversight, autonomic motor pathways adjust cardiac muscle rhythm, rate, and contractile force through balanced sympathetic acceleration and parasympathetic deceleration in response to changing physiological demands and systemic blood pressure requirements.

117. (C) Sympathetic nervous system
Increased sweating and pupil dilation during fear or threat are triggered by the sympathetic nervous system. In response to stressful stimuli, sympathetic fibers stimulate sweat glands to facilitate thermal regulation and contract radial iris muscles to dilate pupils, maximizing visual input as part of the fight-or-flight survival response.

118. (B) Medulla
The medulla oblongata is the lowermost structural region of the brainstem that directly connects the brain to the spinal cord. It serves as a vital conduction pathway for ascending sensory and descending motor nerve tracts while housing fundamental autonomic centers regulating heart rate, blood pressure, and involuntary breathing rhythms.

119. (D) Synapse
A microscopic gap across which nerve impulses pass from one neuron to the next is called a synapse. At this functional junction, the electrical action potential reaching the presynaptic axon terminal triggers the release of neurotransmitters, which diffuse across the synaptic cleft to initiate an electrical impulse in the postsynaptic neuron.

120. (A) A motor neuron transmits impulses away from the CNS to effectors.
A motor neuron is structurally and functionally distinguished by its role in carrying outgoing nerve impulses away from the central nervous system toward target effectors, such as muscles or glands. In contrast, sensory neurons transmit incoming environmental information from peripheral sensory receptors back toward the central brain and spinal cord.

121. (C) Neurotransmitters
Chemical substances responsible for transmitting impulses across a synaptic gap are called neurotransmitters. Synthesized and stored in vesicles at presynaptic axon terminals, these signaling molecules are released upon electrical depolarization, crossing the cleft to bind specific postsynaptic membrane receptors, thereby propagating or inhibiting electrical signals in target cells.

122. (A) Gustatory receptors
Gustatory receptors are specialized chemoreceptors located on the tongue that detect chemical substances released from ingested food. Operating alongside olfactory smell receptors, gustatory cells identify primary taste qualities—sweet, sour, salty, bitter, and umami—generating nerve signals sent to the brain to create the comprehensive sensory perception of flavor.

123. (D) Smell odours
Loss of functional olfactory receptors in the nasal epithelium results in anosmia, the inability to smell odors. Because olfactory receptors are responsible for detecting airborne volatile chemical compounds and transmitting odor signals along the olfactory nerve to the brain, their destruction prevents the perception and identification of scents.

124. (B) Sensory neurons
When a person steps on a sharp stone, pain-detecting receptors in the skin generate electrical impulses. These impulses travel along sensory neurons, which carry incoming signals from peripheral tissues toward the spinal cord. Within the spinal cord, the sensory signal initiates an immediate reflex response and ascends toward the brain.

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not completely enclosed within bony structures, making statement IV false.

146. (A) Cerebellum
The cerebellum is crucial for maintaining equilibrium, spatial orientation, and physical posture during complex motor activities like riding a bicycle. Situated in the hindbrain, it processes continuous sensory input from muscle proprioceptors and inner ear balance organs, fine-tuning voluntary muscle contractions to preserve bodily stability during movement.

147. (C) It triggers the sympathetic division, increasing heart rate
Acute mental stress affects the autonomic nervous system by activating the sympathetic division. This neural activation triggers the emergency fight-or-flight response, accelerating heart rate, elevating blood pressure, dilating respiratory airways, and stimulating glucose release to prepare muscles and vital organs for immediate physical stress or defensive action.

148. (D) Nervous system fatigue and impaired coordination
Prolonged chronic mental stress negatively affects the body, causing nervous system fatigue, sleep disruption, impaired memory, and diminished motor coordination. Sustained elevation of stress hormones like cortisol damages hippocampal neurons, disrupts synaptic plasticity, and exhausts autonomic regulatory mechanisms, reducing overall cognitive performance and emotional well-being over time.

149. (C) The functional reflex arcs and neural pathways
The continuous process from receiving a stimulus to producing a appropriate physiological response depends entirely on functional neural pathways and reflex arcs. Sensory receptors convert environmental energy into nerve signals, which travel along afferent fibers, undergo central integration, and exit via efferent pathways to trigger targeted muscular or glandular actions.

150. (B) Cranial nerves associated with the face and mouth
A patient experiencing difficulty chewing and tasting food most likely suffers from damage to cranial nerves supplying the face and mouth. Specifically, the trigeminal nerve controls jaw muscles involved in chewing, while the facial and glossopharyngeal cranial nerves transmit sensory taste signals from tongue taste buds to the brain.

151. (D) Cerebrum
The cerebrum is not directly involved in executing rapid withdrawal reflexes upon touching a hot object. Simple spinal reflex arcs rely strictly on sensory receptors, afferent neurons, spinal cord interneurons, and efferent motor neurons to move muscles quickly, executing protective actions before conscious cerebral thought and pain perception occur.

152. (A) Inside the spinal cord
In a typical spinal reflex arc, the synapse between a sensory neuron and a motor neuron—or an intervening relay interneuron—occurs within the grey matter of the spinal cord. This central synaptic connection allows sensory signals to be processed locally and immediately converted into outgoing motor execution commands.

153. (C) They ensure unidirectional impulse travel and allow information processing.
Synapses are vital functional structures in the nervous system because they enforce unidirectional travel of nerve impulses and enable complex information processing. By releasing neurotransmitters exclusively from presynaptic terminals to postsynaptic receptors, synapses prevent signal backtracking and allow neurons to integrate, filter, and modify signals throughout neural networks.

154. (A) The next neuron would remain continuously stimulated
If neurotransmitters were not cleared from the synaptic cleft through active enzymatic degradation or presynaptic reuptake, they would remain bound to postsynaptic receptors. This persistent chemical binding would cause continuous, uncontrolled electrical stimulation of the postsynaptic neuron, preventing normal signal resetting and disrupting delicate impulse transmission across neural circuits.

155. (D) Thalamus
The thalamus is often termed the relay center or switchboard of the central nervous system. Situated in the forebrain, it receives sensory information from visual, auditory, gustatory, and somatosensory pathways, sorting and routing these incoming signals to specific sensory areas

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135. (A) I and II
The sympathetic system accelerates heart rate during stress, while the parasympathetic system slows heart rate during rest. However, both subdivisions belong to the autonomic nervous system, which operates completely involuntarily to regulate visceral organs, making the statement asserting direct voluntary conscious control over these autonomic pathways factually incorrect.

136. (A) Optic nerve - Carries auditory signals
The pair linking the optic nerve to auditory signals is incorrect. The optic nerve exclusively carries visual electrical signals from retinal photoreceptors to the visual cortex of the brain. Auditory signals from the inner ear cochlea are transmitted along the auditory nerve, making visual and auditory neural pathways functionally distinct.

137. (C) Epilepsy
Epilepsy is a neurological disorder characterized by abnormal, highly synchronized electrical discharges within brain neurons, leading to unprovoked seizures and physical convulsions. These sudden electrical surges disrupt normal neural signaling, causing temporary disturbances in muscle control, sensory awareness, movement, behavior, and consciousness during clinical seizure episodes.

138. (A) Spinal cord injury
Damage to the lower spinal cord commonly results in paraplegia, which is paralysis affecting the lower half of the body. When spinal nerve tracts are severed or severely crushed, electrical motor and sensory signals cannot travel between the brain and lower limbs, leading to total loss of voluntary movement below injury.

139. (D) Reflex actions of the legs
Spinal cord damage directly interferes with the execution of reflex actions in the legs. Because lower spinal reflex arcs rely on intact neural pathways within the lumbar spinal segments to process sensory input and dispatch motor output, structural spinal injury blocks these local reflex loops, abolishing typical leg reflexes.

140. (A) P-2, Q-1, R-4, S-3
Each medical condition corresponds to a specific neurological cause: paralysis involves the loss of motor function, epilepsy stems from abnormal electrical activity in the brain, blindness results from optic nerve or retinal damage, and deafness arises from damage to the auditory nerve or acoustic hearing structures.

141. (C) Nerve net
Primitive animals like Hydra possess the simplest form of a nervous system, organized as a decentralized nerve net. Consisting of interconnected nerve cells distributed evenly throughout the body wall, this nerve net lacks a centralized brain, allowing simple radial signal conduction and generalized muscular responses to local physical contact.

142. (D) A detectable change in the internal or external environment
A stimulus is defined as any detectable change in an organism's internal or external environment that evokes a functional physiological or behavioral response. Environmental stimuli—such as variations in light, sound, temperature, pressure, or chemical concentration—are detected by specialized sensory receptors, triggering nerve impulses along sensory neural pathways.

143. (B) Dendrite → Cell body → Axon
Within a single neuron, nerve impulses move strictly in one direction: from dendrite to cell body to axon. Dendrites acquire incoming chemical or physical stimuli, converting them into electrical signals that move across the cell body and propagate along the axon toward terminal branches for transmission across the synapse.

144. (B) Peripheral Nervous System
Cranial nerves arising from the brain and spinal nerves originating from the spinal cord together constitute the Peripheral Nervous System. This system connects the Central Nervous System with peripheral organs, sensory receptors, skeletal muscles, and visceral glands, facilitating continuous bidirectional communication of sensory inputs and motor commands throughout body tissues.

145. (A) I, II, and III
The peripheral nervous system connects the central nervous system to limbs and organs, incorporating twelve pairs of cranial nerves and thirty-one pairs of spinal nerves. However, unlike the brain and spinal cord, peripheral nerves extend throughout body tissues and are

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the incoming sound waves, transferring kinetic energy to the middle ear ossicles, which amplify and send the mechanical movement into the fluid-filled cochlea.

167. (D) It regulates and orchestrates the development of other body tissues
The nervous system forms early during embryonic development because it serves as the essential master system that regulates, organizes, and orchestrates the development of other bodily organs and tissues. Early neural connections guide muscle differentiation, organ placement, and systemic physiological integration necessary for complete functional development of the fetus.

168. (A) Spina bifida
Defects in the embryonic development of the nervous system can lead to severe neural tube defects, such as spina bifida. Occurring when the embryonic neural tube fails to close completely during early gestation, spina bifida leaves spinal cord segments and spinal nerves exposed, causing permanent neurological deficits and motor impairment.

169. (C) Cerebrospinal fluid acting as a shock absorber inside the cranium
The brain is protected from minor mechanical shocks and physical jolts by cerebrospinal fluid, which circulates within the cranial cavity and brain ventricles. Suspended in this buoyant liquid, the brain experiences reduced effective weight, while the fluid acts as a physical shock absorber, cushioning delicate neural tissue against impact trauma.

170. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Transmission of a nerve impulse across a chemical synapse is strictly unidirectional. This directional control occurs because chemical neurotransmitters are stored and released exclusively from presynaptic axon terminals, while corresponding neurotransmitter receptors are situated strictly on postsynaptic dendrites or cell bodies, preventing backward electrical transmission across the cleft.

171. (D) It prepares the body for stress and physical activity.
The sympathetic nervous system prepares the body for physical activity, heightened alertness, and environmental stress. Activation of sympathetic pathways accelerates heart rate, elevates arterial blood pressure, dilates bronchial airways, increases blood flow to skeletal muscles, and inhibits digestive functions, optimizing physiological readiness during emergency fight-or-flight situations.

172. (B) Medulla
The rhythmic beating of the heart is an involuntary cardiac action controlled by autonomic cardiovascular centers located within the medulla oblongata. The medulla receives systemic pressure and chemical inputs, sending autonomic nerve signals via sympathetic and parasympathetic nerves to adjust heart rate and cardiac output to match physiological metabolic demands.

173. (C) Cerebrum
Solving a complex mathematical problem requires higher cognitive processing, logical reasoning, and working memory, functions governed entirely by the cerebrum. The cerebral cortex processes numerical concepts, integrates abstract symbolic information, and formulates sequential problem-solving steps through interconnected neural networks distributed across the frontal and parietal cortical lobes.

174. (D) Sponges lack true nervous tissue, unlike complex mammals.
In terms of animal coordination, sponges differ fundamentally from higher mammals because sponges lack true nervous tissue, specialized neurons, and synaptic connections. While mammals possess a centralized nervous system with millions of interconnected neurons, sponges rely on basic cellular communication and direct mechanical responses without any specialized neural network.

175. (A) Retina
When bright light enters the human eye, the retina functions as the primary receptor tissue. Photoreceptor cells within the retina—specifically rod and cone cells—absorb light energy and convert it into electrical signals, which travel along the optic nerve to trigger reflex pupillary constriction and visual perception in the brain.

176. (B) Iris
The characteristic color of a person's eye is determined by the iris. Containing variable concentrations of melanin pigment, the iris is a

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thin, pigmented muscular structure behind the cornea that regulates pupil aperture while giving the eye its distinct visual shade, ranging from brown and hazel to green and blue.

177. (B) Cerebrum
The optic nerve connects the eye directly to visual processing regions located within the cerebrum. Transmitting electrical impulses generated by retinal photoreceptors, the optic nerve passes through the optic chiasm and routes visual information to the primary visual cortex in the occipital lobe of the cerebrum for conscious image perception.

178. (A) The brain interprets signals to form visual images.
When electrical visual signals transmitted along the optic nerve arrive at the primary visual cortex of the brain, complex neural processing occurs. The brain interprets incoming spatial patterns, color frequencies, and motion signals, inverting the inverted retinal image and constructing the clear, upright visual experience of surrounding external environments.

179. (C) Stirrup
The middle ear cavity houses three tiny interconnected bones called auditory ossicles: the hammer (malleus), the anvil (incus), and the stirrup (stapes). These ossicles form a mechanical lever mechanism that amplifies acoustic vibrations transmitted from the eardrum and delivers them to the fluid-filled cochlea of the inner ear.

180. (A) P-2, Q-4, R-1, S-3
Each ear structure fulfills a distinct auditory role: the outer pinna collects external sound waves, the tympanic membrane vibrates in response to sound, the middle ear ossicles amplify mechanical vibrations, and the coiled cochlea converts physical fluid vibrations into electrical neural signals transmitted to the brain.

181. (C) Deafness
Loss of function in the auditory nerve results in sensorineural deafness. Because the auditory nerve is responsible for transmitting electrical signals generated by sensory hair cells in the cochlea to the brain, its damage prevents sound information from reaching auditory processing centers, causing total or partial hearing loss.

182. (B) Psychoactive drug
A chemical substance that alters the normal functioning of central synapses in the brain is classified as a psychoactive drug. Psychoactive substances interact directly with neurotransmitter receptors, alter presynaptic chemical release, or block neurotransmitter reuptake, thereby modifying sensory perception, mood, cognitive processing, consciousness, and behavioral responses in affected individuals.

183. (D) Blinking of the eyes
Blinking of the eyes is an exception to strict voluntary motor control because it functions as both an involuntary reflex and a voluntary action. While individuals can consciously blink, the eye automatically blinks involuntarily as a protective reflex to lubricate the cornea and shield the eye from approaching debris.

184. (A) Cerebellum
The coordination of leg movements while walking is managed by the cerebellum. While the conscious intent to walk originates in the cerebral motor cortex, the cerebellum integrates proprioceptive sensory inputs from skeletal muscles and joints, ensuring smooth, balanced, and synchronized muscular contractions required for steady physical locomotion.

185. (D) I, II and III
Neurotransmitters are synthesized and stored in synaptic vesicles inside presynaptic axon terminals. Upon electrical stimulation, they cross the synaptic cleft to bind specific postsynaptic receptors, where they can either excite the target neuron by inducing depolarization or inhibit it by hyperpolarizing the postsynaptic membrane, modulating signal transmission dynamically.

186. (A) Cell body (Cyton)
The cell body, or cyton, provides metabolic support for the neuron. Housing the cell nucleus, endoplasmic reticulum, Golgi apparatus, and mitochondria, the soma synthesizes essential proteins, enzymes, and chemical neurotransmitters required for maintaining neuronal structural integrity, supporting metabolic cellular repair, and sustaining nerve impulse transmission down the axon.

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187. (D) They form the insulating myelin sheath surrounding peripheral axons
In the peripheral nervous system, Schwann cells play a vital role by wrapping around neuronal axons to form the insulating myelin sheath. This lipid-rich sheath insulates peripheral nerve fibers, prevents electrical signal leakage, and enables rapid saltatory conduction of nerve impulses between adjacent nodes of Ranvier along the axon.

188. (B) Stumbling and uncoordinated walking posture
A person with an injured cerebellum shows signs of motor ataxia, characterized by stumbling, unsteady gait, and uncoordinated walking posture. Because the cerebellum fine-tunes motor execution based on continuous muscle sensory feedback, cerebellar damage impairs motor accuracy, spatial balance, and fluid muscle coordination without causing complete muscular paralysis.

189. (C) Hair
Nervous tissue is absent in human hair. Hair shaft structures consist of non-living, keratinized epithelial cells produced by hair follicles within the skin. Because hair strands lack neurons, specialized sensory receptors, and cellular nerve endings, cutting or trimming hair causes no physical pain or nervous impulse conduction.

190. (A) I, II, and III
Nervous tissue is specialized to receive environmental stimuli, conduct electrical nerve impulses, and form the central nervous system comprising the brain and spinal cord. However, generating mechanical pulling forces to move bones is the specific physiological function of muscular tissue rather than nervous tissue, making the fourth statement incorrect.

191. (A) Pain receptors (nociceptors)
A sharp object piercing the skin directly triggers specialized sensory nerve endings known as nociceptors, or pain receptors. These cutaneous receptors detect mechanical tissue damage and chemical threat signals, converting damaging physical contact into high-frequency electrical action potentials sent along sensory nerves to trigger protective withdrawal reflexes.

192. (B) Neurology
Neurology is the specialized branch of biological medicine that deals with the study, diagnosis, and medical treatment of the nervous system. It focuses on understanding the structure, function, and pathological conditions affecting the brain, spinal cord, peripheral nerves, autonomic ganglia, and effector neuromuscular junctions in living organisms.

193. (B) Abnormal brain electrical discharges using specific anticonvulsant drugs
Epilepsy is best managed medically by controlling abnormal electrical discharges in brain neurons through the systematic administration of specific anticonvulsant medications. Anticonvulsant drugs stabilize neuronal cell membranes, regulate neurotransmitter activity, and suppress excessive electrical hypersynchrony, thereby reducing the frequency, severity, and occurrence of epileptic seizure episodes.

194. (A) Neural canal
The spinal cord traverses the vertebral column through a continuous bony passage called the neural canal. Formed by aligned vertebral foramina of individual stacked vertebrae, the neural canal provides a rigid, protective channel that shields delicate spinal cord tissue, cerebrospinal fluid, and meninges from external impact and mechanical trauma.

195. (A) 4, 2, 3, 1
Organisms arranged by increasing nervous system complexity follow a clear evolutionary progression. Sponges lack true nerve tissue entirely, Hydra possesses a simple decentralized nerve net, earthworms feature a segmented ventral nerve cord with cerebral ganglia, and humans possess a complex centralized brain and highly organized peripheral nervous system.

196. (D) It has a ventral nerve cord and simple cerebral ganglia.
The nervous system of insects, such as cockroaches, consists of paired cerebral ganglia functioning as a primitive brain in the head, connected to a solid ventral nerve cord running along the lower body. Segmental ganglia distributed along the ventral cord regulate localized sensory inputs and motor activities independently.

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38. The brain relies almost exclusively on which nutrient as its energy source?
(A) Glucose
(B) Protein
(C) Fatty acids
(D) Vitamins

39. Which of the following is considered an involuntary action controlled by the brain?
(A) Writing a letter with a pen
(B) Thoroughly chewing food in mouth
(C) Clapping hands together rhythmically
(D) Continuous beating of the heart

40. The human brain consists of grey matter and white matter. The grey matter is primarily composed of:
(A) Calcified osseous bone tissue
(B) Unmyelinated nerve cell bodies
(C) Surrounding cerebrospinal fluid
(D) Outer protective meningeal membranes

41. The forebrain is specialized to receive sensory impulses from various sense organs. Which of the following is not a primary sense organ?
(A) Visual receptors in eyes
(B) Auditory organs in ears
(C) Tactile sensors in skin
(D) The internal stomach

42. When we smell a fragrant flower, the sensory information is interpreted by the:
(A) Medulla
(B) Forebrain
(C) Cerebellum
(D) Pons

43. Which of the following terms describes the response where the brain is not directly involved in producing immediate action, but the spinal cord acts instead?
(A) Voluntary action
(B) Thinking process
(C) Reflex action
(D) Memory recall

44. Even during reflex actions where the spinal cord generates the immediate response, the information eventually reaches the:
(A) Heart
(B) Lungs
(C) Kidneys
(D) Brain

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45. Arrange the following structures from the outermost layer to the innermost layer concerning brain protection:
I. Cerebrospinal fluid
II. Cranium
III. Meninges
IV. Scalp (Skin)
(A) IV, II, III, I
(B) II, IV, I, III
(C) IV, III, II, I
(D) I, III, II, IV

46. What happens if the brain is deprived of oxygen for more than a few minutes?
(A) It switches to using nitrogen gas for energy production.
(B) Brain cells die, causing irreversible tissue damage.
(C) It enters a protective resting state without any damage.
(D) The spinal cord immediately assumes oxygen production.

47. Stress can negatively impact mental health by prolonged activation of which brain-gland axis?
(A) Cerebellum-Medulla central axis
(B) Pons-Thalamus neurological axis
(C) Hypothalamus-Pituitary axis
(D) Cerebrum-Spinal cord main axis

48. Chronic stress is known to primarily impair the brain's ability to:
(A) Form and retrieve memories
(B) Regulate basic breathing
(C) Maintain blood pressure at zero
(D) Digest carbohydrates

49. Which of the following best describes the thalamus?
(A) It is the fluid surrounding and protecting the entire central nervous system.
(B) It is the thick bony structure encasing and covering the hindbrain region.
(C) It relays sensory and motor signals to the cerebral cortex.
(D) It regulates the automatic rhythm and depth of pulmonary breathing.

50. The human brain constitutes roughly what percentage of the total body weight in an average adult?
(A) 2%
(B) 10%
(C) 25%

CHAPTER 06

Human Brain

1. What are the three main parts of the human brain?
(A) Cerebrum, Cerebellum, and Medulla
(B) Forebrain, Midbrain, and Hindbrain
(C) Cranium, Meninges, and Cerebrospinal fluid
(D) Thalamus, Hypothalamus, and Pons

2. Which part of the brain is considered the main thinking part?
(A) Forebrain
(B) Hindbrain
(C) Midbrain
(D) Medulla

3. The cerebrum is a major component of which part of the brain?
(A) Midbrain
(B) Hindbrain
(C) Forebrain
(D) Spinal cord

4. Which region of the brain is primarily responsible for storing memory?
(A) Medulla oblongata
(B) Cerebellum
(C) Pons
(D) Cerebrum

5. Voluntary actions like walking in a straight line are coordinated by which part of the hindbrain?
(A) Medulla
(B) Cerebrum
(C) Cerebellum
(D) Hypothalamus

6. The midbrain is mainly involved in controlling which of the following?
(A) Regulation of gastrointestinal digestion and basal cardiac heart rate
(B) Reflex movements of the head and eyes to visual or auditory stimuli
(C) Advanced cognitive processing involved in human memory and learning
(D) Maintenance of general muscular posture and balance during deep sleep

7. Which of the following is not a part of the hindbrain?
(A) Pons
(B) Medulla
(C) Cerebellum
(D) Thalamus

8. Involuntary actions such as blood pressure, salivation, and vomiting are controlled by the:
(A) Medulla
(B) Cerebrum
(C) Cerebellum
(D) Hypothalamus

9. The bony box that protects the human brain is called the:
(A) Vertebral column
(B) Sternum
(C) Cranium
(D) Meninges

10. What is the primary function of the cerebrospinal fluid (CSF)?
(A) Absorbing mechanical shocks to protect the cranial brain structure
(B) Generating electrical nerve impulses for rapid neuronal signaling
(C) Storing essential molecular oxygen and glucose for brain cells
(D) Replacing the functional role of arterial blood in cerebral tissues

11. The protective membranes enveloping the brain are collectively known as:
(A) Pleura
(B) Pericardium
(C) Synovium
(D) Meninges

12. Which part of the brain regulates body temperature?
(A) Cerebellum
(B) Hypothalamus
(C) Medulla
(D) Thalamus

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197. (C) Beating of the heart
The beating of the heart is an involuntary cardiac action controlled autonomously by intrinsic pacemaker tissues and autonomic brainstem centers, rather than being governed by a simple spinal reflex arc. Reflex arcs involve discrete sensory inputs and localized spinal motor outputs, whereas cardiac contraction operates continuously and automatically.

198. (B) Impulses would travel much slower, delaying bodily response times
If human neurons lacked a myelin sheath, electrical impulses would travel much slower down axons via continuous conduction rather than rapid saltatory jumping. This substantial reduction in impulse conduction velocity would delay reflex responses, slow motor coordination, and impair real-time sensory processing throughout the entire nervous system.

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199. (D) Rest and digest
The rest and digest response is the functional opposite of the emergency fight or flight response. Driven by the parasympathetic nervous system, rest and digest physiological state conserves metabolic energy, slows cardiac rhythms, decreases arterial blood pressure, promotes gastrointestinal digestion, and supports cellular maintenance and tissue repair during quiet resting states.

200. (A) It receives sensory information after the reflex action has occurred.
In a simple reflex action, the brain receives sensory information after the protective reflex response has already been executed by the spinal cord. While the reflex arc operates locally for maximum speed, sensory signals simultaneously ascend to the cerebrum, informing the brain of the event and enabling conscious pain perception.

Which of the given statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

26. Which type of memory holds information for a very brief period before it is either dismissed or transferred?
(A) Long-term memory
(B) Short-term memory
(C) Genetic memory
(D) Procedural memory

27. The continuous electrical and chemical activity in the brain requires a constant supply of:
(A) Nitrogen and carbon dioxide
(B) Lactic acid
(C) Cerebrospinal fluid from the heart
(D) Blood and oxygen

28. Which hormone, controlled by the brain, prepares the body for a "fight or flight" response during stress?
(A) Adrenaline
(B) Insulin
(C) Thyroxine
(D) Estrogen

29. In a normal sleep cycle, brain activity:
(A) Completely stops and ceases all bioelectrical signals
(B) Operates exclusively within lower hindbrain structures
(C) Fluctuates dynamically through continuous varied stages
(D) Shuts down the medulla oblongata respiratory center

30. Consider the following statements about the human brain:
I. The brain is part of the central nervous system.
II. Cerebrospinal fluid provides shock absorption.
III. The cranium is the bony box enclosing the brain.
IV. The midbrain is the largest part of the brain.
Which combination is correct?
(A) I, II, and IV only
(B) I, II, and III only
(C) II, III, and IV only
(D) I, III, and IV only

31. During early embryonic development, the central nervous system begins as a:
(A) Solid bone
(B) Cartilage ring
(C) Muscle fiber
(D) Neural tube

32. Hormonal control of body functions involves coordination between the nervous system and the:
(A) Digestive system
(B) Endocrine system
(C) Skeletal system
(D) Respiratory system

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33. A CT scan of the brain primarily uses which type of technology to create cross-sectional images?
(A) Sound waves
(B) Magnetic fields
(C) X-rays
(D) Infrared radiation

34. The complex behavior of humans compared to other animals is primarily attributed to the high development of the:
(A) Medulla
(B) Cerebellum
(C) Spinal cord
(D) Cerebrum

35. Which of the following represents the correct sequence of brain regions from the anterior (front) to the posterior (back) in a general classification?
(A) Forebrain, Midbrain, Hindbrain
(B) Midbrain, Forebrain, Hindbrain
(C) Hindbrain, Midbrain, Forebrain
(D) Forebrain, Hindbrain, Midbrain

36. Which of the following features best distinguishes the human brain from the brains of lower vertebrates?
(A) An enlarged, highly folded cerebrum
(B) The structural presence of a medulla
(C) Presence of protective cerebrospinal fluid
(D) Connection to a functional spinal cord

37. If a person suffers an injury to the occipital region (back of the cerebrum), which function is most likely to be impaired?
(A) Hearing
(B) Digestion
(C) Vision
(D) Heartbeat

weight of the brain.
(D) It prevents essential cerebrospinal fluid from leaking out of tissue.

89. Which brain part would most likely be active when you are trying to remember the answer to this question?
(A) Medulla
(B) Cerebellum
(C) Cerebrum
(D) Pons

90. Which of the following is not a symptom typically associated with a severe head injury?
(A) Immediate improvement in vision
(B) Sudden or complete loss of consciousness
(C) Persistent episodes of nausea and vomiting
(D) Severe cognitive memory confusion

91. The feeling of thirst is initiated by the brain when it detects:
(A) Unusually high molecular oxygen levels in circulating blood
(B) Decreased water content in body fluids
(C) Elevated ambient environmental temperature outside
(D) Complete distension of a full stomach

92. Which statement regarding the relationship between the brain and the pituitary gland is correct?
(A) The pituitary gland directly regulates and dictates conscious thoughts in the brain.
(B) Brain signals instruct the pituitary gland on hormone release.
(C) The pituitary gland completely replaces the functional respiratory role of the medulla.
(D) They operate entirely independently and share no functional physiological relationship.

93. CT stands for Computed Tomography. It is commonly used to diagnose:
(A) Isolated bone fractures in lower leg extremities
(B) Structural brain damage, bleeding, or tumors
(C) Continuous variations in heart rate variability
(D) Systemic physiological blood sugar glucose levels

94. The brain's ability to change, adapt, and form new neural connections throughout life in response to learning is generally referred to as:
(A) Brain paralysis
(B) Brain calcification
(C) Epilepsy
(D) Neuroplasticity

95. Both Assertion (A) and Reason (R) are given below.
Assertion (A): The brain needs the cranium and cerebrospinal fluid.
Reason (R): The brain is a delicate organ that can easily be damaged by mechanical shock.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

96. Which area of the brain is crucial for maintaining the body's sleep-wake cycle (circadian rhythm)?
(A) Hypothalamus
(B) Cerebellum
(C) Medulla
(D) Spinal cord

97. Identify the correct pair.
(A) Cerebrospinal fluid - Transmits nerve impulses
(B) Pons - Stores memory
(C) Cranium - Bone structure protecting the brain
(D) Thalamus - Regulates posture

98. Find the odd one out based on voluntary/ involuntary functions.
(A) Swallowing food
(B) Pumping of the heart
(C) Secretion of saliva
(D) Kicking a football

99. The phrase "fight or flight" response is closely associated with which brain-regulated mechanism?
(A) Sympathetic activation of adrenal glands
(B) Endocrine secretion of insulin from pancreatic tissue
(C) Generalized relaxation of somatic skeletal muscles
(D) Parasympathetic activation of the digestive system

100. Match List I with List II.
List I: (Condition/Feature)
P. Meninges
Q. Cranium
R. CT Scan
S. Paralysis

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(D) 50%

51. Which structure connects the two hemispheres of the cerebrum, allowing them to communicate?
(A) Medulla oblongata
(B) Cerebellum
(C) Meninges
(D) Corpus callosum

52. The right side of the human brain primarily controls the movements of:
(A) The left side of the body
(B) The right side of the body
(C) The upper half of the body only
(D) The lower half of the body only

53. If a patient experiences a stroke that damages the left cerebral hemisphere, which of the following is a common outcome?
(A) Paralysis on the left side of the body
(B) Complete loss of hearing in both ears
(C) Paralysis on the right side of the body
(D) Inability to breathe without assistance

54. Identify the incorrect statement regarding the human brain.
(A) The brain is protected by the cranium.
(B) The forebrain is the main thinking part of the brain.
(C) The cerebrospinal fluid acts as a shock absorber.
(D) The medulla controls voluntary movements.

55. Both Assertion (A) and Reason (R) are given below.
Assertion (A): The hypothalamus is essential for survival.
Reason (R): It regulates vital functions like body temperature, hunger, and thirst.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

56. Identify the correct pair.
(A) Hypothalamus - Temperature regulation
(B) Cerebellum - Storage of long-term memories
(C) Medulla - Complex voluntary actions
(D) Midbrain - Automatic heartbeat control

57. The brain and spinal cord together constitute the:
(A) Peripheral Nervous System
(B) Autonomic Nervous System
(C) Somatic Nervous System
(D) Central Nervous System

58. The nerves that arise directly from the brain are called:
(A) Cranial nerves
(B) Spinal nerves
(C) Motor nerves only
(D) Autonomic nerves only

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59. How many pairs of cranial nerves are present in a human being?
(A) 10
(B) 31
(C) 12
(D) 43

60. Match List I with List II.
List I: (Process/Disorder)
P. Paralysis
Q. Epilepsy
R. Memory formation
S. Sleep cycle
List II: (Associated with)
1. Recurrent brain seizures
2. Cerebrum and neural connections
3. Loss of motor function
4. Fluctuating brain wave activity
(A) P-3, Q-1, R-2, S-4
(B) P-1, Q-3, R-4, S-2
(C) P-3, Q-2, R-1, S-4
(D) P-2, Q-4, R-3, S-1

61. Short-term memory is often converted into long-term memory through a process that is reinforced by:
(A) Decrease in oxygen supply
(B) Physical damage to the cranium
(C) Repetition and adequate sleep
(D) Stopping the blood flow to the brain

62. Which of the following is an exception to the functions of the hindbrain?
(A) Controlling and maintaining body posture and physical balance
(B) Regulating normal pulmonary respiration and breathing rate
(C) Controlling systemic cardiovascular blood pressure levels
(D) Interpreting complex visual and sensory information

63. What is the primary role of the meninges?
(A) To generate conscious thoughts and complex

cognitive ideas
(B) To secrete regulatory hormones directly into blood circulation
(C) To provide structural protection to the brain
(D) To absorb and digest excess cranial cerebrospinal fluid

64. A person is unable to walk in a straight line after consuming excessive alcohol. Which part of the brain is most affected?
(A) Cerebrum
(B) Hypothalamus
(C) Medulla
(D) Cerebellum

65. Consider the following statements regarding the midbrain:
I. It is situated between the forebrain and hindbrain.
II. It is primarily responsible for advanced mathematical reasoning.
III. It controls certain visual and auditory reflexes.
Which of the given statements is/are incorrect?
(A) I only
(B) II only
(C) III only
(D) I and III

66. The "master gland" that the brain uses to control many other endocrine glands is the:
(A) Thyroid gland structure
(B) Adrenal gland complex
(C) Pituitary gland
(D) Pancreas tissue

67. The pituitary gland is anatomically located immediately below the:
(A) Cerebellum
(B) Medulla
(C) Spinal cord
(D) Hypothalamus

68. Identify the incorrect statement about voluntary and involuntary actions.
(A) Beating of the heart is a voluntary action.
(B) Voluntary actions require conscious thought.
(C) Involuntary actions happen without conscious control.
(D) Picking up a pencil is a voluntary action.

69. Which part of the brain contains the respiratory rhythm centre?
(A) Cerebrum
(B) Hypothalamus
(C) Medulla
(D) Thalamus

70. Consider the following statements:
I. The brain is well protected by the skull.
II. CSF is found between the meninges.
III. The brain controls both voluntary and involuntary actions.
IV. Sleep is unnecessary for normal brain function.
Which combination is correct?
(A) I, II, and III only
(B) I, II, and IV only
(C) II, III, and IV only
(D) I, III, and IV only

71. Find the odd one out based on brain structure.
(A) Cerebrum
(B) Thalamus
(C) Hypothalamus
(D) Cerebellum

72. Which portion of the brain makes up the largest volume in humans?
(A) Cerebrum
(B) Cerebellum
(C) Medulla
(D) Pons

73. During embryonic development, the forebrain primarily differentiates to form the:
(A) The entire length of the spinal cord
(B) Lower hindbrain structures like medulla and pons
(C) Cerebrum and diencephalon structures
(D) Structural bones forming the outer cranium

74. Which diagnostic test records the electrical activity of the brain to detect abnormalities like epilepsy?
(A) ECG (Electrocardiogram) monitoring
(B) Diagnostic ultrasound imaging
(C) Comprehensive blood test panel
(D) EEG (Electroencephalogram)

75. Which brain injury precaution is mandated by law in most regions for two-wheeler riders?
(A) Wearing sunglasses
(B) Wearing earplugs
(C) Wearing a helmet
(D) Wearing a heavy jacket

76. Why is a constant blood supply to the brain critical?
(A) Brain cells cannot store oxygen or glucose

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reserves.
(B) The developing brain requires continuous blood flow to form cranial bones.
(C) Blood serves as the primary liquid shock absorber protecting brain tissue.
(D) Blood directly converts into cerebrospinal fluid inside individual neurons.

77. Which symptom is least likely to be caused by brain damage?
(A) Memory loss
(B) Paralysis
(C) Altered behavior
(D) Muscle growth

78. In a reflex arc involving touching a hot object, which component directly receives the signal from the sensory neuron before sending it to the motor neuron?
(A) Cerebrum
(B) Cerebellum
(C) Spinal cord
(D) Hypothalamus

79. While riding a bicycle, maintaining balance and coordinating pedaling is the primary responsibility of the:
(A) Medulla
(B) Hypothalamus
(C) Thalamus
(D) Cerebellum

80. The human brain communicates with the rest of the body through a network of nerves. Which statement is correct?
(A) It communicates exclusively through the central pathways of the spinal cord.
(B) It communicates via cranial nerves and the spinal cord.
(C) It relies entirely on bloodborne hormones without utilizing nerve pathways.
(D) It communicates throughout the body primarily via the lymphatic system.

81. Which part of the brain handles language processing and speech comprehension in most humans?
(A) Cerebrum
(B) Cerebellum
(C) Medulla
(D) Pons

82. Which of the following protects the brain from bacterial infections present in the general blood circulation?
(A) Cerebrospinal fluid
(B) Blood-brain barrier
(C) Cranium
(D) Meninges alone

83. The human brain operates through electrical impulses transmitted by specialized cells called:
(A) Nephrons
(B) Erythrocytes
(C) Neurons
(D) Osteocytes

84. Which process requires the coordination of both the brain and the sense organs?
(A) Simple digestion of food in the stomach
(B) Filtering of blood by the kidneys
(C) Secretion of bile
(D) Catching a moving ball

85. Which sequence outlines the correct flow of information when you see a glass of water and reach out to pick it up?
(A) Eyes → Forebrain → Motor nerves → Arm muscles
(B) Forebrain → Eyes → Motor nerves → Arm muscles
(C) Arm muscles → Eyes → Forebrain → Motor nerves
(D) Eyes → Arm muscles → Motor nerves → Forebrain

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86. A person suffering from epilepsy should:
(A) Be administered regular electric shocks daily
(B) Completely avoid taking prescribed neurological medications
(C) Seek medical supervision for seizure management
(D) Stop sleeping at night to prevent all seizures

87. What is a common cause of paralysis?
(A) A severe viral or bacterial infection in the gastrointestinal stomach
(B) A stroke cutting off cerebral blood supply
(C) Excessive daily dietary consumption of vitamin C supplements
(D) Regularly sleeping for significantly more than eight hours daily

88. The surface of the human cerebrum is highly convoluted (folded). What is the main advantage of this structure?
(A) It expands cerebral surface area for neurons.
(B) It creates an aesthetically appealing anatomical brain structure.
(C) It significantly decreases the total physical

13. The sensation of feeling full (satiety) is associated with a specific centre located in the:
(A) Cerebellum
(B) Hindbrain
(C) Forebrain
(D) Midbrain

14. Which brain structure is directly linked to the pituitary gland and controls its secretions?
(A) Cerebrum
(B) Medulla
(C) Pons
(D) Hypothalamus

15. Both Assertion (A) and Reason (R) are given below.
Assertion (A): The cerebellum is responsible for the precision of voluntary actions.
Reason (R): It controls involuntary functions like heartbeat and breathing.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

16. Which of the following actions is not controlled by the cerebrum?
(A) Solving a complex mathematical puzzle accurately
(B) Blinking of eyes in response to a bright light
(C) Remembering and recalling a past personal event
(D) Formulating a structured sentence before speaking

17. The reflex centres for vision and hearing are located in the:
(A) Forebrain
(B) Midbrain
(C) Hindbrain
(D) Spinal cord

18. Which structure acts as a bridge between different parts of the brain and regulates respiration?
(A) Pons
(B) Cerebellum
(C) Cerebrum
(D) Hypothalamus

19. Damage to the cerebellum will most likely affect which of the following?
(A) Long-term memory storage and cognitive recall
(B) Regulation of endocrine hormone secretion
(C) Maintaining body balance and posture
(D) Gastrointestinal digestion and absorption

20. Match List I with List II.
List I: (Brain Part)
P. Cerebrum
Q. Cerebellum
R. Medulla
S. Hypothalamus
List II: (Function)
1. Blood pressure control
2. Temperature regulation
3. Posture and balance
4. Thinking and intelligence
(A) P-4, Q-3, R-1, S-2
(B) P-4, Q-1, R-3, S-2
(C) P-3, Q-4, R-1, S-2
(D) P-2, Q-3, R-1, S-4

21. Which part of the central nervous system extends downwards from the medulla?
(A) Pituitary gland
(B) Cranial nerves
(C) Spinal cord
(D) Hypothalamus

22. Epilepsy is a neurological disorder primarily characterized by:
(A) Progressive and permanent loss of memory
(B) Recurrent unprovoked neurological seizures
(C) Chronic inability to digest dietary food
(D) Total and complete loss of visual perception

23. Paralysis can often occur due to:
(A) Overproduction and accumulation of cranial cerebrospinal fluid
(B) Abnormal increase in bone density throughout the cranium
(C) Prolonged episodes of excessive daytime sleeping and fatigue
(D) Disruption of blood supply to motor areas of the brain

24. A severe head injury is most safely prevented by:
(A) Wearing a protective helmet
(B) Drinking sufficient water daily
(C) Consuming a protein-rich diet
(D) Taking daily vitamin supplements

25. Consider the following statements about the cerebrum:
I. It is a part of the forebrain.
II. It controls voluntary actions.
III. It regulates the heartbeat.

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List II: (Description)
1. Loss of muscle function
2. Protective brain membranes
3. Bony skull structure
4. Brain imaging technique

(A) P-2, Q-3, R-4, S-1
(B) P-3, Q-2, R-4, S-1
(C) P-2, Q-3, R-1, S-4
(D) P-4, Q-1, R-2, S-3

101. Which process represents a reflex action rather than a conscious brain decision?
(A) Solving a complex logical puzzle or riddle
(B) Carefully deciding what meals to eat for dinner
(C) Instantly withdrawing a hand from a hot pan
(D) Reading and comprehending an academic book

102. An injury to the medulla oblongata is often fatal because it controls:
(A) Processing speech and auditory hearing
(B) Long-term memory and emotional response
(C) Physical balance and gait while walking
(D) Vital breathing and cardiac heart rate

103. Which of the following is true about the embryonic development of the brain?
(A) It develops from the endoderm.
(B) It starts as a simple neural tube.
(C) The hindbrain develops first, followed by the spine.
(D) The cerebrum does not develop until after birth.

104. Which part of the brain is primarily affected when a person suffers from a lack of motor coordination and balance?
(A) Cerebrum
(B) Cerebellum
(C) Hypothalamus
(D) Pituitary gland

105. Consider the following statements about memory:
I. Short-term memory has a limited capacity.
II. Long-term memory involves structural and chemical changes in the brain.
III. The medulla is the primary site of long-term memory storage.
Which of the given statements is/are correct?
(A) I only
(B) I and II only
(C) II and III only
(D) I, II, and III

106. In the context of brain anatomy, what does "CSF" stand for?
(A) Central Spinal Fluid
(B) Cerebrospinal Fluid
(C) Cranial Sensory Fluid
(D) Cerebral Synaptic Fluid

107. The brain's main connection to the peripheral nervous system throughout the body is the:
(A) Cerebellum
(B) Vagus nerve only
(C) Olfactory nerve
(D) Spinal cord

108. A person is exhibiting sudden, uncoordinated outbursts of physical activity and altered consciousness. This is most characteristic of:
(A) Epilepsy
(B) Sleep apnea
(C) Color blindness
(D) Indigestion

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109. Which of the following is a function of the pons?
(A) It actively produces and secretes cerebral spinal fluid.
(B) It stores complex visual memories and sensory images.
(C) It relays signals and assists in breathing control.
(D) It precisely regulates internal core body temperature.

110. Consider the following statements about the human nervous system:
I. The brain is the main coordinating centre of the body.
II. The spinal cord is protected by the vertebral column.
III. Sensory nerves carry signals from the brain to the muscles.
IV. Motor nerves carry signals from the brain to the muscles.
Which combination is correct?
(A) I, II, and IV only
(B) I, II, and III only
(C) II, III, and IV only
(D) I, III, and IV only

111. Which structure prevents the brain from collapsing under its own weight inside the skull?
(A) The extensive surrounding network of cranial nerves
(B) The structural hardness of individual brain

protection to brain tissues.
(B) It actively facilitates metabolic exchange of nutrients and cellular waste.
(C) It is physically located within spaces between outer meningeal layers.
(D) It carries oxygen like red blood cells.

184. The coordination of the endocrine system and nervous system is primarily handled by the:
(A) Medulla
(B) Hypothalamus
(C) Pons
(D) Cerebellum

185. Consider the following statements about the human brain:
I. It is enclosed in the cranium.
II. It requires continuous blood flow.
III. It cannot process sensory information.
Which of the given statements is/are correct?
(A) I only
(B) I and II only
(C) II and III only
(D) I, II, and III

186. Which characteristic clearly differentiates human brains from those of other primates?
(A) The universal evolutionary presence of a well-developed posterior cerebellum
(B) The presence of three protective meningeal membranes surrounding the brain
(C) Larger size and complexity of the cerebral cortex
(D) The basic physiological autonomic functioning of lower medulla structures

187. In an EEG, what does the machine record?
(A) Intracranial blood pressure inside cerebral arteries
(B) Electrical activity of brain neurons
(C) Molecular oxygen saturation levels in brain tissues
(D) Total physical volumetric size of cranial structures

188. Which structure is a part of the central nervous system but is located outside the cranial cavity?
(A) Cerebrum
(B) Medulla
(C) Spinal cord
(D) Hypothalamus

189. Which part of the brain relays signals between the cerebrum and the cerebellum?
(A) Medulla
(B) Pons
(C) Hypothalamus
(D) Spinal cord

190. Consider the following statements regarding brain health:
I. Helmets prevent skull fractures and brain injuries.
II. Prolonged stress improves long-term memory.
III. Sleep helps consolidate memories.
IV. A stroke is caused by interrupted blood supply.
Which combination is correct?
(A) I, II, and III only
(B) I, III, and IV only
(C) II, III, and IV only
(D) I, II, and IV only

191. During a medical examination, an MRI is chosen over a CT scan mainly to:
(A) Clear soft tissue imaging without radiation
(B) See hard skeletal bones of the outer cranium skull more clearly
(C) Complete full structural scanning procedures in under two seconds
(D) Accurately measure exact internal physiological core body temperature

192. Which function is considered a purely voluntary action?
(A) Pupil dilation in darkness
(B) Digestion of proteins
(C) Choosing a pen to write
(D) Heart beating

193. The primary reason a person becomes paralyzed after a severe spinal cord injury is that:
(A) The brain immediately and completely ceases producing essential oxygen.
(B) Motor signal pathways to muscles are severed.
(C) Somatic skeletal muscle fibers physically dissolve and disappear over time.
(D) Shock-absorbing cerebrospinal fluid dries up completely within the spine.

194. Mental health issues are increasingly linked to the brain's handling of:
(A) Cellular molecular oxygen supply
(B) Stress and chemical imbalances
(C) Regular physical body exercise
(D) Gastrointestinal nutrient digestion

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124. Which part of the brain is directly involved in generating the emotional responses of fear and pleasure?
(A) Cerebellum structures regulating muscle balance and movement
(B) Medulla oblongata regions controlling cardiovascular activity
(C) Pons areas serving as relay bridges for respiratory signals
(D) Limbic system and hypothalamic areas of the forebrain

125. Which sequence best represents the general structural division of the brain from bottom (connecting to the spinal cord) to top?
(A) Cerebrum, Midbrain, Medulla
(B) Medulla, Pons, Midbrain, Cerebrum
(C) Cerebrum, Medulla, Pons, Midbrain
(D) Pons, Medulla, Cerebrum, Midbrain

126. A neurologist taps a patient's knee with a hammer, and the leg kicks forward. This reflex is processed by the:
(A) Cerebrum
(B) Midbrain
(C) Cerebellum
(D) Spinal cord

127. Which condition is caused by abnormal and excessive electrical discharges in the brain?
(A) Epilepsy
(B) Meningitis
(C) Paralysis
(D) Stroke

128. What is the primary reason the brain requires cerebrospinal fluid?
(A) To digest and metabolize complex food particles in brain cells
(B) To provide buoyancy and absorb mechanical shocks
(C) To act as a solid physical barrier against bacterial infection
(D) To assist directly in the enzymatic clotting of cranial blood

129. If the cerebellum of an animal is damaged, it will have difficulty in:
(A) Digesting and absorbing nutrients from ingested food
(B) Regulating its basal resting cardiovascular heartbeat
(C) Seeing and recognizing distant environmental objects
(D) Walking smoothly and maintaining physical balance

130. The cranium is composed of:
(A) Dense flexible cartilaginous tissue only
(B) Rigid interlocking flat cranial bones
(C) Contractile muscular tissue layers
(D) Complex conductive nervous tissue

131. Which of the following best describes neuroplasticity?
(A) The physical process of the human brain turning into synthetic plastic after death
(B) The permanent physical rigidity and hardness of the brain inside the skull cavity
(C) The brain's capacity to form new neural connections
(D) The complete inability of adult brain cells to learn new things past childhood

132. Which imaging technique uses powerful magnets and radio waves to create detailed images of the brain?
(A) X-ray
(B) Ultrasound
(C) MRI
(D) ECG

133. Which gland is often referred to as the "master gland" but is itself under the control of the hypothalamus?
(A) Thyroid
(B) Adrenal
(C) Pituitary
(D) Pancreas

134. Which of the following functions does the brain carry out?
(A) Continuous pumping of blood throughout the body
(B) Filtering blood and excreting metabolic urine
(C) Breaking down and digesting dietary proteins
(D) Coordinating overall bodily functions

135. Both Assertion (A) and Reason (R) are given below.
Assertion (A): The cerebrum is highly folded in humans.
Reason (R): Folding reduces the number of neurons to make the brain lighter.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true

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160. Which of the following is not a symptom of a stroke?
(A) Sudden numbness or weakness in the face, arm, or leg
(B) Sudden confusion or trouble speaking
(C) Sudden trouble walking or dizziness
(D) Sudden increase in hair growth

161. A condition where the brain's blood supply is severely reduced, causing brain cells to die, is known as a:
(A) Myocardial infarction
(B) Gastric ulcer
(C) Stroke
(D) Kidney failure

162. How does the brain respond to an increase in carbon dioxide levels in the blood?
(A) Medulla signals lungs to breathe faster.
(B) The cerebrum completely ceases all voluntary muscle movements.
(C) The cerebellum immediately slows down the cardiovascular heart rate.
(D) The hypothalamus drastically decreases internal core body temperature.

163. Which part of the brain would be most heavily involved when a musician is playing a complex piece on the piano, requiring precise finger coordination?
(A) Medulla
(B) Cerebellum
(C) Hypothalamus
(D) Pons

164. What is the main reason a person loses consciousness during a severe head impact?
(A) Sudden, massive overproduction of dysfunctional memory cells
(B) Disruption of normal brain electrical activity
(C) Immediate physical freezing of cranial cerebrospinal fluid
(D) The surrounding protective skull bone cracking loudly

165. Arrange the following events of a reflex action in the correct order:
I. Sensory neuron transmits signal.
II. Receptor detects stimulus.
III. Motor neuron transmits signal.
IV. Spinal cord processes signal.
V. Effector reacts.
(A) II, I, IV, III, V
(B) I, II, IV, III, V
(C) II, IV, I, III, V
(D) IV, II, I, V, III

166. A doctor suspects a patient has epilepsy. Which test will they most likely order to observe the electrical activity of the brain?
(A) Blood sugar test
(B) EEG
(C) Chest X-ray
(D) Endoscopy

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167. Why do humans have a relatively larger forebrain compared to other animals?
(A) To store and circulate significantly more cerebrospinal fluid
(B) To support higher cognition, language, and reasoning
(C) To maintain automatic basal respiratory breathing functions
(D) To increase the overall physical weight and size of the head

168. Which part of the brain is the primary centre for regulating feelings of hunger and thirst?
(A) Cerebellum
(B) Medulla
(C) Hypothalamus
(D) Pons

169. What role does the skull (cranium) play in relation to the brain?
(A) It actively generates and matures new functional neurons.
(B) It acts as a rigid, protective outer skull shell.
(C) It pumps and circulates oxygenated blood to brain cells.
(D) It interprets and processes sensory neural information.

170. Which of the following is a direct consequence of a completely severed spinal cord in the neck region?
(A) Complete, permanent loss of cognitive memory
(B) Chronic inability to digest dietary food particles
(C) Paralysis of the body below the neck
(D) Immediate and total permanent ocular blindness

171. Which condition results in unprovoked seizures due to chaotic electrical activity in the brain?
(A) Asthma
(B) Diabetes
(C) Epilepsy

(C) Protect them from injury while seizure resolves
(D) Pour cold water directly onto their face immediately

148. Which factor is most important for maintaining good brain health?
(A) Adequate sleep and balanced diet
(B) Maintaining consistently high physiological stress levels
(C) Following a strictly sedentary daily lifestyle routine
(D) Completely avoiding all intellectual mental challenges

149. Paralysis is typically defined as the:
(A) Total loss of tactile temperature sensation across the skin
(B) Complete auditory inability to hear environmental sounds
(C) Loss of voluntary muscle movement in body parts
(D) Chronic gastrointestinal inability to digest solid food

150. Consider the following statements regarding brain functioning:
I. The left hemisphere generally controls the right side of the body.
II. The right hemisphere generally controls the left side of the body.
III. The cerebrum handles involuntary reflexes like coughing.
IV. The hypothalamus controls the pituitary gland.
Which combination is correct?
(A) I, II, and III only
(B) I, II, and IV only
(C) II, III, and IV only
(D) I, III, and IV only

151. Which part of the brain is closely associated with maintaining an individual's personality?
(A) Medulla oblongata autonomic centers
(B) Pons structures linking brain regions
(C) Frontal areas of the cerebrum
(D) Cerebellum motor balance centers

152. In an emergency, which part of the brain rapidly signals the adrenal glands to release adrenaline?
(A) Hypothalamus
(B) Cerebellum
(C) Occipital lobe
(D) Meninges

153. What separates the brain from direct contact with the inner surface of the skull?
(A) A dense, thick layer of protective skeletal muscle
(B) Rigid hyaline cartilage tissue lining the inner skull
(C) An empty air cavity space separating tissue from bone
(D) The protective meninges and cerebrospinal fluid

154. The midbrain connects the forebrain to the:
(A) Spinal cord directly
(B) Hindbrain
(C) Pituitary gland
(D) Cranium

155. Consider the following statements about the spinal cord:
I. It is an extension of the medulla oblongata.
II. It is involved in reflex actions.
III. It is protected by the cranium.
Which of the given statements is/are incorrect?
(A) I only
(B) II only
(C) III only
(D) I and II

156. Find the odd one out.
(A) Conscious deep logical thinking
(B) Long-term cognitive remembering
(C) Salivating when seeing food
(D) Solving complex math problems

157. Which imaging scan relies on X-rays to generate detailed cross-sectional views of the brain?
(A) MRI
(B) CT Scan
(C) Ultrasound
(D) EEG

158. Which of the following is true about cerebrospinal fluid (CSF)?
(A) It flows outside the skull.
(B) It is a hard, rigid structure.
(C) It bathes the brain and spinal cord.
(D) It is red in color due to hemoglobin.

159. The central nervous system processes information and sends a decision to the effectors. What are effectors?
(A) Sensory organs like eyes
(B) Bones
(C) Blood vessels
(D) Muscles and glands

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ANSWERS

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1. (B) Forebrain, Midbrain, and Hindbrain
The human brain is structurally divided into three major primary regions based on anatomical layout and functional specialization. These main regions comprise the forebrain, midbrain, and hindbrain. The forebrain manages complex cognitive thought processes, the midbrain processes sensory visual and auditory reflexes, while the hindbrain regulates essential vital autonomic functions alongside physical motor balance.

2. (A) Forebrain
The forebrain forms the largest and most complex portion of the central nervous system in humans. It contains specialised regions responsible for processing sensory input, facilitating conscious thought, reasoning, learning, and decision-making. High-level cognitive processes, abstract intelligence, and voluntary actions are governed by this region, making it the principal thinking center of the brain.

3. (C) Forebrain
The cerebrum constitutes the largest structural region of the human forebrain. It consists of two major cerebral hemispheres covered by the cerebral cortex. This extensive structure processes complex sensory information, controls voluntary muscle movements, and manages higher cognitive capabilities including reasoning, problem-solving, speech, emotional processing, and long-term memory retrieval across various cerebral lobes.

4. (D) Cerebrum
Memory storage and recall processes are primarily localized within the outer cerebral cortex and associated limbic structures of the cerebrum. The cerebrum forms intricate neural networks that encode, consolidate, and retrieve short-term and long-term memories. This enables humans to learn from experience, retain vast amounts of information, and retrieve knowledge during conscious cognitive processing.

5. (C) Cerebellum
The cerebellum is a key structure located at the lower back region of the hindbrain. It specializes in coordinating voluntary muscle movements, maintaining posture, ensuring bodily balance, and refining precise physical motor control. Smooth physical movements such as walking along a straight line, riding a bicycle, or picking up fine objects depend on cerebellar processing.

6. (B) Reflex movements of the head and eyes to visual or auditory stimuli
The midbrain serves as an essential connecting pathway between the forebrain and hindbrain. It plays a pivotal role in mediating visual and auditory reflexes. Sudden movements of the head, neck, and trunk in response to unexpected visual light changes or loud auditory noises are integrated directly within the neural relay centers of the midbrain.

7. (D) Thalamus
The hindbrain consists of three primary structures, which are the pons, cerebellum, and medulla oblongata. These structures coordinate involuntary vital functions and physical motor posture. In contrast, the thalamus is an integral part of the forebrain, acting as a major sensory relay station that routes incoming sensory signals directly to the outer cerebral cortex.

8. (A) Medulla
The medulla oblongata is situated in the lowest region of the hindbrain, connecting directly to the spinal cord. It serves as the primary control center for crucial involuntary physiological functions. Essential biological activities such as heart rate control, blood pressure regulation, salivation, swallowing, coughing, and vomiting reflexes are automatically regulated by neural nuclei in the medulla.

9. (C) Cranium
The brain is housed within the cranial cavity of the skull, protected by a hard skeletal casing known as the cranium. This rigid structure consists of strong interlocking bones that shield the delicate soft nervous tissue of the central nervous system from direct mechanical impacts, external physical trauma, pressure, and surrounding environmental injuries.

(D) Arthritis

172. The term "grey matter" in the brain refers to tissue that contains a high concentration of:
(A) Myelinated axons
(B) Neuron cell bodies
(C) Cerebrospinal fluid
(D) Red blood cells

173. What is the fundamental difference between an MRI and a CT scan of the brain?
(A) MRI relies on harmful X-rays; CT scan utilizes sound waves.
(B) MRI uses a magnetic field; CT scan uses X-rays.
(C) MRI evaluates bone structures only; CT scan images soft tissue.
(D) MRI involves invasive surgery; CT scan requires no surgery.

174. Which process allows humans to retain facts and recall them during an examination?
(A) Cerebral memory formation
(B) Rapid involuntary spinal reflex action
(C) Endocrine hormone secretion by the medulla
(D) Gastrointestinal digestion in the stomach

175. Both Assertion (A) and Reason (R) are given below.
Assertion (A): The brain is highly vulnerable to oxygen deprivation.
Reason (R): Brain cells lack the ability to store significant reserves of oxygen and energy.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

176. Which part of the brain is constantly active even when a person is in a deep coma, ensuring basic life support?
(A) Cerebrum
(B) Medulla
(C) Frontal lobe
(D) Cerebellum

177. The nervous system in humans consists of:
(A) Brain, spinal cord, and cranial bones exclusively
(B) Peripheral motor and sensory nerves only
(C) Brain, spinal cord, and network of nerves
(D) Brain, heart, and systemic blood vessels

178. What happens to memory consolidation when a person undergoes chronic sleep deprivation?
(A) It improves significantly and functions at peak cognitive capacity.
(B) It remains entirely unaffected by lack of rest.
(C) It is severely impaired, hindering learning.
(D) Short-term memories automatically convert into long-term memories.

179. A person touches a sharp pin and instantly pulls their hand away. Which part of the nervous system is primarily responsible for this quick reaction?
(A) Cerebrum
(B) Spinal cord
(C) Cerebellum
(D) Hypothalamus

180. Match List I with List II.
List I: (Activity)
P. Balancing on a tightrope
Q. Feeling hungry
R. Solving a math problem
S. Sneezing
List II: (Brain Area Responsible)
1. Cerebrum
2. Medulla
3. Cerebellum
4. Hypothalamus
(A) P-3, Q-4, R-1, S-2
(B) P-1, Q-2, R-3, S-4
(C) P-3, Q-1, R-4, S-2
(D) P-2, Q-4, R-1, S-3

181. Which brain structure is heavily involved in regulating the body's internal clock and sleep-wake cycles?
(A) Medulla oblongata rhythm centers
(B) Pons respiratory bridge structures
(C) Hypothalamic circadian centers
(D) Lower spinal cord neural pathways

182. A patient experiences sudden loss of memory and difficulty forming new memories after an accident. Which part of the brain was likely injured?
(A) Medulla
(B) Cerebrum
(C) Spinal cord
(D) Cerebellum

183. Identify the incorrect statement about cerebrospinal fluid (CSF).
(A) It provides essential mechanical shock

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tissues
(C) The external insulating layer of hair on the scalp
(D) Buoyancy provided by cerebrospinal fluid

112. The structural and functional unit of the brain is the:
(A) Alveolus
(B) Neuron
(C) Nephron
(D) Villi

113. What is the gap between two neurons in the brain where chemical communication occurs called?
(A) Axon
(B) Dendrite
(C) Synapse
(D) Myelin

114. MRI is a superior imaging technique for the brain because it:
(A) Utilizes high doses of harmful ionizing X-ray radiation
(B) Images soft tissues clearly without X-rays
(C) Can only evaluate high-density calcified bone structure
(D) Involves invasive minor surgical diagnostic procedures

115. Arrange the path of an impulse during a voluntary action (like writing):
I. Motor neuron
II. Forebrain (decision making)
III. Hand muscles (effector)
IV. Spinal cord
(A) II, IV, I, III
(B) II, I, IV, III
(C) IV, II, I, III
(D) I, II, IV, III

116. Which of the following is not true regarding the human brain's energy consumption?
(A) It requires a constant supply of glucose.
(B) It consumes a large percentage of the body's total oxygen.
(C) It is highly metabolically active even during sleep.
(D) It can function for hours without oxygen.

117. What distinguishes human memory capabilities from those of most other animals?
(A) Human brains lack short-term memory capabilities entirely.
(B) Humans possess vast language and abstract memory capacity.
(C) Human memories are stored exclusively within the spinal cord.
(D) Human memory processing operates entirely without neurons.

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118. Which statement about the meninges is incorrect?
(A) They surround only the brain, not the spinal cord.
(B) They are protective membranes.
(C) Inflammation of these membranes is called meningitis.
(D) They lie just beneath the cranium.

119. A major difference between a reflex action and walking is that walking is:
(A) Controlled exclusively by the lower spinal cord
(B) Significantly faster than an involuntary reflex
(C) A voluntary action controlled by the brain
(D) An automatic involuntary reflex action

120. Which feature indicates that a behavior is likely controlled by the cerebrum?
(A) It happens automatically without thinking.
(B) It requires conscious learning and practice.
(C) It occurs while the person is in a deep coma.
(D) It only involves internal organs like the stomach.

121. The regulation of breathing during sleep is primarily ensured by the:
(A) Cerebrum hemispheres
(B) Hypothalamus center
(C) Frontal lobe cortex
(D) Medulla and Pons

122. Which term best describes a sudden interruption in the blood supply of the brain?
(A) Epilepsy
(B) Brain tumor
(C) Stroke
(D) Concussion

123. The thalamus acts primarily as a:
(A) Relay station for sensory and motor signals
(B) Primary respiratory centre controlling automatic breathing
(C) Main cortical storage unit for long-term memory recall
(D) Primary endocrine gland secreting systemic growth hormone

195. Consider the following statements about involuntary actions:
I. They are controlled largely by the hindbrain and midbrain.
II. They happen without our conscious will.
III. Writing a letter is an example of an involuntary action.
Which of the given statements is/are incorrect?
(A) I only
(B) II only
(C) III only
(D) I and II

196. The development of the brain in the embryonic stage begins with the formation of the:
(A) Spinal cord first
(B) Neural tube
(C) Cranial bones first
(D) Nerves of the limbs

197. Find the odd one out based on the part of the brain they belong to.
(A) Cerebrum
(B) Thalamus
(C) Hypothalamus
(D) Medulla

198. Consider the following structures:
I. Cerebrum
II. Cerebellum
III. Pons
IV. Medulla
Which of these belong to the hindbrain?
(A) I, II, and III
(B) II, III, and IV
(C) I, III, and IV
(D) I, II, and IV

199. What protects the spinal cord in a manner similar to how the cranium protects the brain?
(A) Dense protective meningeal layers only
(B) Thoracic sternum bone structure
(C) Bony vertebral column
(D) Protective thoracic rib cage

200. What is the ultimate control centre that dictates human behaviour, learning, and physical action?
(A) The heart
(B) The brain
(C) The spinal cord
(D) The endocrine glands

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but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

136. Which center of the brain is crucial for learning a new language?
(A) Medulla
(B) Cerebrum
(C) Cerebellum
(D) Hypothalamus

137. Identify the incorrect pair regarding brain protection.
(A) Cranium - Bone structure
(B) Meninges - Protective membranes
(C) Cerebrospinal fluid - Shock absorption
(D) Corpus callosum - Fluid inside the skull

138. The part of the brain that integrates sensory information with past experiences to make a decision is the:
(A) Forebrain
(B) Midbrain
(C) Hindbrain
(D) Spinal cord

139. Excessive mental stress over a long period can lead to which of the following?
(A) Significantly improved cognitive and long-term memory
(B) Marked increase in overall physical brain size and volume
(C) Mental health disorders such as anxiety or depression
(D) Dramatically enhanced physiological function of the medulla

140. Match List I with List II.
List I: (Brain Area)
P. Occipital region (Forebrain)
Q. Temporal region (Forebrain)
R. Motor area (Forebrain)
S. Medulla
List II: (Function)
1. Voluntary muscle movement
2. Breathing control
3. Vision processing
4. Hearing processing
(A) P-3, Q-4, R-1, S-2
(B) P-4, Q-3, R-2, S-1
(C) P-3, Q-1, R-4, S-2
(D) P-1, Q-2, R-3, S-4

141. The olfactory lobes in the brain are responsible for the sense of:
(A) Sight
(B) Hearing
(C) Smell
(D) Taste

142. If a person suffers a severe blow to the back of the head, which vital function is most at risk due to potential medulla damage?
(A) Abstract thinking
(B) Smell
(C) Hearing
(D) Respiration

143. Which of the following activities does not involve conscious brain activity?
(A) Reading a novel
(B) Digesting a meal
(C) Playing chess
(D) Painting a picture

144. Sleep is essential for the brain primarily because it:
(A) Allows the brain to completely shut down and save energy
(B) Stops the beating of the heart temporarily
(C) Prevents the production of cerebrospinal fluid
(D) Facilitates memory consolidation and neural repair

145. Consider the following statements about head injuries:
I. They can cause permanent memory loss.
II. Wearing a helmet provides mechanical protection to the cranium.
III. They always result in immediate death.
Which of the given statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III

146. Which part of the brain coordinates the muscles of the mouth, tongue, and larynx during speech?
(A) Medulla oblongata respiratory centers
(B) Motor cortex and cerebellum areas
(C) Hypothalamic autonomic centers
(D) Midbrain sensory reflex centers

147. What is the most appropriate action if someone is experiencing a seizure (epileptic fit)?
(A) Hold their limbs down forcefully to prevent movement
(B) Place a hard metal spoon inside their mouth quickly

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10. (A) Absorbing mechanical shocks to protect the cranial brain structure
Cerebrospinal fluid is a clear protective fluid circulating within the brain ventricles and surrounding meningeal spaces. Its primary physiological function is to provide mechanical protection by acting as a shock absorber. It cushions delicate neural tissue against physical impacts, maintains constant intracranial pressure, provides structural buoyancy, and facilitates waste removal from central nervous tissue.

11. (D) Meninges
The human brain and spinal cord are enclosed and protected by three distinct layers of protective membranes collectively called the meninges. These layers comprise the dura mater, arachnoid mater, and pia mater. Together with circulating cerebrospinal fluid between these membranes, the meninges shield central nervous tissue against mechanical trauma, physical friction, and external environmental injury.

12. (B) Hypothalamus
The hypothalamus is a specialized neural center located at the base of the forebrain. It acts as the principal regulator of thermoregulation, constantly monitoring and maintaining internal core body temperature. By activating sweating, shivering, or altering blood vessel diameter, the hypothalamus ensures thermostatic equilibrium alongside controlling hunger, thirst, and hormone release.

13. (C) Forebrain
The sensation of hunger and satiety is controlled by dedicated specialized centers localized within the forebrain, specifically inside the hypothalamus. These neural circuits analyze circulating nutrient levels, hormonal signals, and stomach distension to signal when the body requires food intake or when full nourishment has been reached, effectively terminating eating behavior.

14. (D) Hypothalamus
The hypothalamus is directly connected to the pituitary gland via a thin neural stalk. It functions as the master integrator between the nervous system and the endocrine system. By secreting releasing and inhibiting neurohormones, the hypothalamus directly controls the synthesis and release of various metabolic, growth, and reproductive hormones from the pituitary gland.

15. (C) Assertion (A) is true but Reason (R) is false.
The cerebellum accurately regulates motor precision, fine movement coordination, and balance during voluntary muscular activities, making the first statement true. However, involuntary functions such as heartbeat, blood pressure, and breathing are governed by the medulla oblongata, not the cerebellum. Therefore, the supporting explanation provided is factually incorrect regarding hindbrain functional assignments.

16. (B) Blinking of eyes in response to a bright light
Blinking in response to a sudden bright light is an immediate involuntary reflex action mediated rapidly by lower neural centers such as the midbrain and spinal cord. In contrast, complex conscious processes like mathematical problem-solving, memory recall, and language formulation require active cognitive analysis and processing carried out exclusively within the cerebral cortex.

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17. (B) Midbrain
Sensory reflex processing for visual and auditory inputs is concentrated within the midbrain region. Specialized neural structures inside the midbrain integrate visual tracking movements and auditory orientation, allowing rapid involuntary head and eye adjustments toward sudden sounds or unexpected light stimuli before conscious cortical awareness and higher intellectual processing take place.

18. (A) Pons
The pons is a structural component of the hindbrain located superior to the medulla. It contains nerve fiber tracts that act as a bridge connecting different regions of the brain. Additionally, the pons contains pneumotaxic and apneustic respiratory centers that work directly with the medulla oblongata to regulate breathing rhythm.

19. (C) Maintaining body balance and posture
Structural damage to the cerebellum significantly disrupts motor coordination, balance control, and postural alignment. Because the cerebellum continuously integrates sensory feedback from muscles, joints, and the inner ear to adjust motor outputs, an injury leads to uncoordinated muscle movements, unsteady gait, loss of balance, and

102. (D) Vital breathing and cardiac heart rate
Severe physical trauma to the medulla oblongata is frequently fatal because this vital hindbrain center contains primary autonomic cardiorespiratory control centers. The medulla regulates fundamental life-sustaining processes, including basic pulmonary breathing rhythms, resting heart rate, vascular blood pressure, swallowing mechanisms, and critical cardiac reflexes.

103. (B) It starts as a simple neural tube.
Early embryonic development of the central nervous system begins with the formation of a hollow neural tube along the dorsal ectoderm. This primitive neural tube subsequently differentiates along its length, expanding anteriorly to form the forebrain, midbrain, and hindbrain, while the elongated posterior section forms the spinal cord.

104. (B) Cerebellum
The cerebellum is the primary integration center for fine motor control, body equilibrium, and movement coordination. When cerebellar function is impaired by physical injury, structural degeneration, or chemical depression, an individual exhibits persistent loss of physical balance, unsteady muscle coordination, continuous tremors, and an erratic walking gait.

105. (B) I and II only
Short-term memory has a strict capacity limit, holding minimal data temporarily, whereas long-term memory formation involves structural synaptic remodeling and protein synthesis across cerebral cortical networks. Long-term memory consolidation occurs primarily within cerebral and hippocampal networks rather than the medulla oblongata, making the third statement incorrect.

106. (B) Cerebrospinal Fluid
In human neuroanatomy, the acronym CSF designates cerebrospinal fluid. This clear, colorless bodily fluid circulates continuously through the ventricular system of the brain, the central canal of the spinal cord, and the surrounding subarachnoid space, providing essential mechanical shock absorption, structural buoyancy, and metabolic waste removal.

107. (D) Spinal cord
The spinal cord is the primary neural highway connecting the brain to the peripheral nervous system. Traversing the protective vertebral column, it collects sensory information from peripheral nerves throughout the body to relay upward to the brain, while simultaneously conveying descending motor signals down from the brain to peripheral muscle effectors.

108. (A) Epilepsy
Sudden outbursts of uncoordinated motor activity, uncontrollable muscle twitching, altered consciousness, or sensory disturbances are classic symptoms of an epileptic seizure. These transient episodes result from abnormal, excessive, and highly synchronized electrical activity arising spontaneously within hypersensitive, disrupted neuronal populations inside the human brain.

109. (C) It relays signals and assists in breathing control.
The pons is a vital hindbrain structure situated directly above the medulla oblongata. It functions primarily as a major neural relay bridge conveying nerve signals between the cerebrum, cerebellum, and spinal cord. Furthermore, it contains specialized pneumotaxic centers that fine-tune pulmonary respiratory transition rhythms.

110. (A) I, II, and IV only
The central nervous system serves as the body's primary control center, with the spinal cord housed safely inside the protective vertebral column. Motor nerves convey descending commands from the brain to effector muscles. Sensory nerves, however, carry ascending inputs from sensory organs to the brain, making the third statement false.

111. (D) Buoyancy provided by cerebrospinal fluid
Cerebrospinal fluid fills the subarachnoid space surrounding the brain, suspending the organ in a liquid environment. This fluid immersion provides natural physical buoyancy, reducing the effective weight of the brain from approximately 1400 grams to just 50 grams, preventing lower neural tissues and blood vessels from collapsing under its weight.

112. (B) Neuron
The fundamental structural and functional unit of the human brain and overall nervous system

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cellular damage, clear metabolic waste products, and reorganize synaptic connections for optimal cognitive functioning.

30. (B) I, II, and III only
The central nervous system includes the brain, which is shielded by the bony cranium and cushioned by shock-absorbing cerebrospinal fluid. However, the cerebrum, not the midbrain, constitutes the largest portion of the human brain. The midbrain is actually a small region connecting the forebrain and hindbrain, making the fourth statement incorrect.

31. (D) Neural tube
During early embryonic development, specialized ectodermal tissue folds inward and fuses to form the neural tube. This hollow embryonic structure serves as the fundamental precursor to the entire central nervous system, subsequently differentiating into the forebrain, midbrain, hindbrain, and the elongated spinal cord as development progresses.

32. (B) Endocrine system
Integrated regulation of body functions relies on close functional coordination between the rapid electrical nervous system and the chemical endocrine system. The brain, particularly through the hypothalamus, controls endocrine glands that secrete hormones directly into the bloodstream, thereby managing long-term physiological processes like growth, metabolism, stress response, and reproductive development.

33. (C) X-rays
Computed Tomography imaging utilizes specialized rotating X-ray equipment combined with computer processing algorithms to produce detailed cross-sectional images of the brain. These high-resolution cross-sectional slices enable medical professionals to visualize bone structures, soft brain tissues, vascular blood vessels, internal hemorrhages, tumors, and structural lesions clearly for accurate medical diagnosis.

34. (D) Cerebrum
Advanced behavioral complexity, abstract reasoning, symbolic language, and problem-solving abilities in humans are primarily driven by the extensive evolutionary development of the cerebrum. The highly expanded cerebral cortex contains billions of interconnected neurons capable of processing intricate sensory inputs, formulating logical plans, and executing sophisticated voluntary motor patterns.

35. (A) Forebrain, Midbrain, Hindbrain
Spatial organization of major brain divisions along the anterior-to-posterior axis begins with the forebrain at the front and top, transitions through the centrally located midbrain, and ends with the hindbrain at the base, which connects seamlessly to the spinal cord entering the vertebral column.

36. (A) An enlarged, highly folded cerebrum
The human brain is distinguished from lower vertebrate brains primarily by its massively enlarged and heavily folded cerebrum. The extensive cortical convolutions, consisting of gyri and sulci, dramatically increase the available surface area for neural cell bodies, facilitating superior cognitive processing, abstract reasoning, complex language comprehension, and refined voluntary motor control.

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37. (C) Vision
The occipital lobe located at the rear portion of the cerebrum houses the primary visual cortex. Direct physical trauma or injury to this specific posterior cerebral region impairs the processing of visual information, leading to partial or total vision loss, visual hallucinations, or difficulty recognizing visual patterns, shapes, and colors.

38. (A) Glucose
Brain tissue relies almost exclusively on simple glucose as its primary metabolic energy fuel. Transports across the blood-brain barrier supply glucose continuously, which brain cells break down aerobically to generate adenosine triphosphate necessary for maintaining ionic gradients, generating action potentials, and sustaining continuous neurotransmitter synthesis across active synapses.

39. (D) Continuous beating of the heart
Cardiac muscle contractions driving the continuous beating of the heart occur automatically without conscious intervention, making heart activity an essential involuntary process controlled by lower brain centers like the medulla oblongata. Conversely, activities such as writing, chewing food, and clapping hands require conscious thought and voluntary cerebral motor commands.

repetition reinforces synaptic pathways, while adequate sleep provides essential resting phases during which the brain reorganizes, stabilizes, and cements newly acquired knowledge into long-term cortical networks.

62. (D) Interpreting complex visual and sensory information
The hindbrain consists of the pons, medulla, and cerebellum, which together coordinate physical balance, posture, cardiovascular functions, and basic respiratory rhythm. Higher-level cognitive processing, visual pattern interpretation, and complex sensory evaluation are exclusive functions of the forebrain's cerebral cortex rather than lower hindbrain structures.

63. (C) To provide structural protection to the brain
The primary anatomical function of the meninges is to provide multi-layered structural protection for delicate brain and spinal cord tissue. Together with circulating cerebrospinal fluid in the subarachnoid space, these fibrous connective tissue membranes shield central nervous system structures from physical impact, shearing forces, and dangerous mechanical shock.

64. (D) Cerebellum
Alcohol directly depresses functional activity within the cerebellum, which is the primary motor coordination center of the hindbrain. Impaired cerebellar function disrupts fine muscle control, spatial orientation, and gait balance, causing an intoxicated individual to stagger, lose physical balance, and experience great difficulty walking along a straight line.

65. (B) II only
The midbrain lies positioned between the forebrain and hindbrain, playing an essential role in routing sensory information and coordinating auditory and visual reflexes. Advanced mathematical reasoning and logical problem-solving, however, are governed by complex association areas within the cerebral cortex of the forebrain, making the second statement incorrect.

66. (C) Pituitary gland
The pituitary gland is frequently termed the master gland because its hormones regulate numerous other endocrine glands throughout the body, including the thyroid, adrenal cortex, and gonads. Located at the base of the brain, its endocrine secretions are tightly governed by regulatory neurohormones released from the overlying hypothalamus.

67. (D) Hypothalamus
The pituitary gland sits within a bony depression at the base of the skull directly below the hypothalamus. It connects to the hypothalamus via a slender vascular and neural stalk called the infundibulum, allowing direct regulatory neurohormones and electrical signals from the hypothalamus to dictate pituitary endocrine hormone production.

68. (A) Beating of the heart is a voluntary action.
Cardiac muscle contractions driving the beating heart occur continuously under autonomic control without conscious intervention, making heart activity an involuntary process governed by the medulla oblongata. Voluntary actions, such as picking up an object, require intentional conscious thought and active motor signal initiation within the cerebral cortex.

69. (C) Medulla
The respiratory rhythm center is located within the medulla oblongata in the hindbrain. This autonomic center continuously monitors chemical changes in blood blood chemistry, specifically carbon dioxide and pH levels, generating periodic rhythmic electrical signals that drive intercostal muscle and diaphragm contractions to maintain appropriate pulmonary ventilation.

70. (A) I, II, and III only
The human brain is protected by the bony cranium, cushioned by cerebrospinal fluid circulating within the meninges, and regulates both voluntary movements and involuntary autonomic processes. However, sleep is crucial for metabolic waste clearance and neural repair, making the fourth statement factually incorrect regarding brain physiological health.

71. (D) Cerebellum
The cerebrum, thalamus, and hypothalamus are all integrated components belonging to the forebrain division. Conversely, the cerebellum is an anatomically distinct structure located in the hindbrain division, specialized primarily for fine motor control, physical balance, and posture maintenance, making it different from the other forebrain structures listed.

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to its intense metabolic and electrical energy requirements.

51. (D) Corpus callosum
The corpus callosum is a thick, wide nerve tract consisting of hundreds of millions of myelinated nerve fibers bridging the left and right cerebral hemispheres. This massive commissural structure enables continuous, rapid interhemispheric communication, integrating sensory processing, motor control, and cognitive operations across both sides of the brain.

52. (A) The left side of the body
Motor control in the human central nervous system is predominantly contralateral due to the decussation of corticospinal nerve tracts in the brainstem. As a result, the motor cortex within the right cerebral hemisphere initiates and regulates physical movements, muscle contractions, and tactile sensations on the left side of the body.

53. (C) Paralysis on the right side of the body
Because main motor nerve pathways cross over at the base of the brain stem, motor centers in the left cerebral hemisphere govern voluntary movements on the right side of the body. A cerebral stroke damaging motor tissue in the left hemisphere prevents nerve impulses from reaching target muscles, causing right-sided paralysis.

54. (D) The medulla controls voluntary movements.
The medulla oblongata is a hindbrain structure strictly specialized for controlling crucial involuntary autonomic functions like heart rate, digestion, swallowing, and respiration. Voluntary body movements, such as walking, writing, or lifting objects, are planned and executed by motor areas in the cerebrum and coordinated by the cerebellum, not the medulla.

55. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
The hypothalamus is crucial for physiological survival because it serves as the primary homeostatic integration center of the human body. By continuously monitoring and regulating core internal parameters like body temperature, fluid balance, hunger, thirst, and hormone balance, the hypothalamus ensures the internal environment remains within stable operational limits.

56. (A) Hypothalamus - Temperature regulation
The hypothalamus acts as the primary thermal regulation center in the brain, continuously adjusting autonomic responses to maintain a stable core body temperature. In contrast, the cerebellum handles motor balance rather than long-term memory, the medulla manages involuntary autonomic functions rather than voluntary movements, and the midbrain regulates sensory reflexes.

57. (D) Central Nervous System
The human nervous system is anatomically divided into major branches. The central nervous system consists exclusively of the brain and the spinal cord, serving as the main command and processing hub. Peripheral nerves extending throughout the body connect to this central axis to form the peripheral nervous system.

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58. (A) Cranial nerves
Nerves that emerge directly from the underside of the brain and brainstem, rather than passing through the spinal cord, are designated as cranial nerves. These specialized nerves innervate sensory receptors and motor structures predominantly located throughout the head, face, neck, and major thoracic and abdominal organs.

59. (C) 12
Human neuroanatomy features exactly twelve paired sets of cranial nerves emerging symmetrically from the base of the brain and brainstem. Designated by Roman numerals I through XII, these cranial nerves carry sensory information, motor signals, or parasympathetic innervation to structures primarily in the head, neck, and upper torso.

60. (A) P-3, Q-1, R-2, S-4
Neurological concepts correspond to distinct physiological phenomena. Paralysis involves a loss of motor function due to nerve damage. Epilepsy is characterized by recurrent unprovoked electrical seizures. Memory formation occurs through dynamic neural connections within the cerebrum, while normal sleep cycles involve fluctuating, characteristic brain wave patterns.

61. (C) Repetition and adequate sleep
Consolidating fragile short-term memories into stable, long-term memory storage requires structural and biochemical synaptic modifications within cerebral neural networks. Active cognitive

40. (B) Unmyelinated nerve cell bodies
Grey matter in the central nervous system consists primarily of neuronal cell bodies, dendrites, unmyelinated axons, glial cells, and capillaries. Its grey appearance distinguishes it from white matter, which is composed mainly of myelinated axon tracts responsible for transmitting electrical signals between different processing regions of the brain.

41. (D) The internal stomach
Primary sensory organs comprise specialized external receptors including the eyes, ears, nose, tongue, and skin, which detect visual, auditory, olfactory, gustatory, and tactile stimuli for forebrain processing. The internal stomach is an visceral organ involved in digestion rather than a primary sense organ collecting external sensory environmental information.

42. (B) Forebrain
Olfactory sensory information generated by nasal receptors travels along olfactory nerves directly to the olfactory bulbs and olfactory cortex, which are localized within the forebrain. The forebrain processes, interprets, and identifies these chemical scent signals, enabling conscious recognition and emotional association with specific aromas like floral fragrances.

43. (C) Reflex action
A reflex action is an immediate, involuntary motor response to a sensory stimulus that operates without direct initial conscious decision-making by the brain. The neural circuit, known as a reflex arc, routes sensory signals directly through the spinal cord to trigger rapid motor responses, minimizing potential tissue damage during dangerous situations.

44. (D) Brain
During a spinal reflex, the immediate motor response is executed directly through neural pathways within the spinal cord for maximum speed. Simultaneously, ascending sensory interneurons relay copies of the sensory stimulus upward to the brain, allowing conscious awareness, pain perception, memory encoding, and subsequent voluntary behavioral adjustments to take place.

45. (A) IV, II, III, I
Structural protection of the central nervous system proceeds sequentially from outermost to innermost layers. The scalp forms the outer skin covering, followed by the rigid bony cranium. Beneath the skull lie the membranous meninges, and directly surrounding and bathing the delicate tissue of the brain is the cerebrospinal fluid.

46. (B) Brain cells die, causing irreversible tissue damage.
Human brain cells require a constant supply of molecular oxygen to maintain cellular respiration and ionic equilibrium. Depriving brain tissue of oxygen for more than a few minutes leads to rapid metabolic failure, irreversible neuronal cell death, severe cognitive or motor deficits, brain damage, or permanent functional impairment.

47. (C) Hypothalamus-Pituitary axis
Prolonged physical or emotional stress triggers continuous neuroendocrine activity along the hypothalamic-pituitary-adrenal axis. The hypothalamus secretes releasing factors that prompt the pituitary gland to stimulate systemic adrenal stress hormone release. Chronic elevation of these hormones negatively alters brain structure, impairs neurogenesis, and disrupts emotional and cognitive health.

48. (A) Form and retrieve memories
Chronic elevated stress levels cause sustained release of glucocorticoid hormones like cortisol, which damages delicate neural connections within the hippocampus and prefrontal cortex. This physiological disruption severely impairs neuroplasticity, reducing the brain's ability to encode, consolidate, retain, and effectively retrieve both short-term and long-term memories.

49. (C) It relays sensory and motor signals to the cerebral cortex.
The thalamus is a large mass of grey matter positioned in the dorsal part of the diencephalon within the forebrain. It acts as the major central routing hub, receiving ascending sensory inputs from various pathways and relaying them precisely to specific functional areas of the cerebral cortex for conscious interpretation.

50. (A) 2%
In an average adult human, the brain weighs approximately 1.3 to 1.4 kilograms, representing roughly two percent of total body mass. Despite this small physical proportion, the brain receives approximately twenty percent of total resting cardiac output and oxygen supply due

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72. (A) Cerebrum
The cerebrum is the largest component of the human brain, occupying approximately eighty-five percent of total cranial volume. Divided into two large cerebral hemispheres, its extensive outer cerebral cortex contains billions of neurons responsible for processing sensory data, governing voluntary motor commands, and directing high-level cognitive processes.

73. (C) Cerebrum and diencephalon structures
During early embryonic neural development, the primary forebrain vesicle (prosencephalon) differentiates into two secondary regions: the telencephalon and diencephalon. The telencephalon expands dramatically to form the cerebral hemispheres and cerebrum, while the diencephalon develops into crucial central forebrain structures, including the thalamus and hypothalamus.

74. (D) EEG (Electroencephalogram)
An electroencephalogram is a non-invasive diagnostic technique that records the continuous bioelectrical activity of the brain. Sensors placed on the scalp detect microvolt electrical fluctuations produced by firing cortical neurons, enabling clinicians to identify abnormal electrical wave patterns associated with neurological conditions like epilepsy and sleep disorders.

75. (C) Wearing a helmet
Wearing an approved protective safety helmet is legally mandated for motorcycle and bicycle riders to prevent traumatic brain injury. Helmets absorb mechanical impact energy during collisions, distribute kinetic forces across a broad rigid surface area, and reduce the risk of skull fractures, intracranial hemorrhages, and brain contusions.

76. (A) Brain cells cannot store oxygen or glucose reserves.
Neurons require a continuous supply of blood because brain tissue lacks energy reserves to store glucose or oxygen. A uninterrupted arterial blood flow is essential to supply metabolic substrate continuously, ensuring unbroken aerobic cellular respiration to fuel continuous ionic pump activity and electrical nerve signal transmission.

77. (D) Muscle growth
Physical damage to central nervous system tissue impairs neural processing, manifesting as loss of memory, paralysis, altered behavioral patterns, or sensory loss. Skeletal muscle growth, however, depends primarily on mechanical workload, resistance exercise, physical training, and protein nutrient intake rather than direct pathological damage inside brain tissue.

78. (C) Spinal cord
In a rapid spinal reflex arc triggered by a painful stimulus, sensory neurons transmit nerve impulses directly into the grey matter of the spinal cord. Here, interneurons immediately process the incoming signal and relay electrical commands to motor neurons, triggering rapid muscle contraction before conscious awareness develops in the brain.

79. (D) Cerebellum
Executing coordinated physical activities like riding a bicycle requires continuous motor adjustments driven by the cerebellum. The cerebellum receives sensory inputs from the eyes, skeletal muscles, joints, and vestibular equilibrium organs, processing this information to refine motor outputs that maintain bodily posture, balance, and smooth, synchronized leg movements.

80. (B) It communicates via cranial nerves and the spinal cord.
Structural communication between the brain and peripheral organs occurs through two major neural pathways. Twelve pairs of cranial nerves emerge directly from the brain to service the head, face, and internal visceral organs, while thirty-one pairs of spinal nerves branch off the spinal cord to supply the rest of the body.

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81. (A) Cerebrum
Language processing, speech comprehension, and articulate vocal formulation are specialized cognitive functions located within specific regions of the cerebral cortex, such as Broca's area and Wernicke's area in the cerebrum. These interconnected cerebral zones analyze symbolic language patterns, formulate meaningful sentences, and coordinate motor commands for speech production.

impaired manual dexterity during voluntary actions.

20. (A) P-4, Q-3, R-1, S-2
Neural structures possess specialized physiological functions within the central nervous system. The cerebrum governs intelligence, abstract thinking, and memory. The cerebellum regulates physical posture, muscle balance, and motor coordination. The medulla oblongata controls vital involuntary actions such as blood pressure and breathing, while the hypothalamus acts as the primary body temperature regulator.

21. (C) Spinal cord
The spinal cord is a continuous cylindrical bundle of nerve tissue extending downwards from the base of the medulla oblongata through the protective vertebral column. It serves as the primary communication pathway transmitting sensory and motor nerve signals between the brain and the rest of the peripheral nervous system throughout the body.

22. (B) Recurrent unprovoked neurological seizures
Epilepsy is a chronic neurological disorder characterized by recurrent, unprovoked electrical disturbances in the brain. These abnormal hyper-synchronous electrical discharges disrupt normal neuronal communication, leading to sudden involuntary muscle convulsions, temporary loss of awareness, altered sensory perception, or total loss of consciousness during unprovoked epileptic seizure episodes.

23. (D) Disruption of blood supply to motor areas of the brain
Paralysis frequently occurs when the blood supply to specific motor control areas of the brain is interrupted, such as during an ischemic stroke. Deprived of oxygen and essential nutrients, motor neurons undergo rapid damage or cell death, preventing the transmission of electrical nerve signals to skeletal muscles, resulting in lost voluntary movement.

24. (A) Wearing a protective helmet
Severe traumatic brain injuries during vehicular impacts or physical accidents are most effectively prevented by wearing a properly fitted safety helmet. A helmet absorbs mechanical kinetic energy, distributes impact forces across a wider area, and protects the underlying rigid cranium and delicate central nervous tissue from skull fractures and brain contusions.

25. (A) I and II only
The cerebrum is the main functional component of the forebrain and is fully responsible for regulating voluntary muscle activities, intelligence, memory, and conscious thought. However, fundamental involuntary functions such as cardiac heartbeat regulation are governed by the medulla oblongata located in the hindbrain, making the third statement incorrect regarding cerebral function.

26. (B) Short-term memory
Short-term memory holds a limited amount of information in an active, readily available state for a brief temporal duration, typically ranging from a few seconds to a minute. Unless the information is actively rehearsed or consolidated into long-term storage through neural reinforcement, it rapidly decays and is discarded by the brain.

27. (D) Blood and oxygen
Continuous electrical and chemical signalling within human brain tissue demands an uninterrupted delivery of oxygen and glucose provided by constant blood circulation. Because neurons possess virtually no energy storage reserves, even a momentary interruption in cerebral blood flow deprives brain tissue of necessary oxygen, rapidly impairing cellular function and causing tissue damage.

28. (A) Adrenaline
During stressful or dangerous situations, the sympathetic nervous system triggers the rapid secretion of adrenaline from the adrenal medulla. Controlled by hypothalamic brain signals, adrenaline increases heart rate, dilates respiratory airways, elevates blood glucose levels, and redirects blood flow toward skeletal muscles, preparing the body for an immediate fight-or-flight response.

29. (C) Fluctuates dynamically through continuous varied stages
Brain activity during sleep does not shut down; instead, it undergoes dynamic cyclic fluctuations between non-rapid eye movement and rapid eye movement stages. Each sleep stage exhibits distinct electrical wave patterns, during which neural networks consolidate memories, repair

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92. (B) Brain signals instruct the pituitary gland on hormone release.
The brain maintains direct neuroendocrine control over the pituitary gland through the hypothalamus. Neurosecretory cells in the hypothalamus synthesize specialized releasing and inhibiting hormones that travel down the hypophyseal portal system, directly commanding the anterior pituitary gland to release or suppress specific systemic metabolic hormones.

93. (B) Structural brain damage, bleeding, or tumors
Computed Tomography scanning uses focused X-rays and computer algorithms to generate precise cross-sectional images of internal skull structures. Clinicians routinely utilize brain CT scans to rapidly evaluate traumatic injuries, detect acute intracranial hemorrhages, identify structural strokes, diagnose brain tumors, and assess abnormal cerebral tissue swelling.

94. (D) Neuroplasticity
Neuroplasticity describes the dynamic capability of the central nervous system to adapt its structural organization and functional connections throughout life. Through activity-dependent mechanisms, brain neurons forge new synaptic connections, strengthen existing neural pathways, or reorganize cortical areas in response to ongoing learning, environmental experiences, or recovery from brain injury.

95. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Brain tissue is soft and highly sensitive to mechanical trauma. To prevent structural injury during physical impacts, the central nervous system requires outer mechanical shielding provided by the rigid bony cranium alongside physical shock-absorbing buoyancy provided by surrounding fluid cushions like cerebrospinal fluid circulating within the meninges.

96. (A) Hypothalamus
Circadian sleep-wake cycles are regulated primarily by the suprachiasmatic nucleus located within the hypothalamus. Functioning as the body's master biological clock, this neural structure processes environmental light cues received from retina receptors to synchronize hormonal secretions, metabolic activity, body temperature fluctuations, and daily sleep-wake states.

97. (C) Cranium - Bone structure protecting the brain
The cranium is the rigid, protective bony skull casing that houses and shields the brain from mechanical impact. Conversely, cerebrospinal fluid acts as a protective shock absorber rather than an electrical signal transmitter, the pons functions as a respiratory and neural bridge, and the thalamus serves as a sensory relay center.

98. (D) Kicking a football
Kicking a football is a voluntary physical action under intentional conscious control, initiated by motor centers in the cerebral cortex. In contrast, swallowing food, cardiac heart pumping, and salivation in response to taste are governed by automatic involuntary autonomic neural mechanisms located within lower brain regions like the medulla oblongata.

99. (A) Sympathetic activation of adrenal glands
The fight-or-flight stress reaction is an automated autonomic response orchestrated by the hypothalamus. Threat perception activates the sympathetic nervous system, prompting the adrenal medulla to release adrenaline and noradrenaline into the bloodstream, elevating heart rate, increasing blood pressure, dilating airways, and preparing skeletal muscles for emergency physical activity.

100. (A) P-2, Q-3, R-4, S-1
Anatomical structures and neurological concepts pair directly with their physiological definitions. The meninges are multi-layered protective membranes covering central nervous tissue. The cranium forms the bony skull enclosure. Computed Tomography serves as an advanced cross-sectional brain imaging technique, while paralysis denotes a complete loss of voluntary muscle movement.

101. (C) Instantly withdrawing a hand from a hot pan
Instantly pulling a hand back from a hot surface is an automatic reflex action. High-temperature thermal painful stimuli trigger impulses along sensory neurons directly to spinal cord interneurons, which immediately fire motor signals to arm muscles, producing a rapid withdrawal response before conscious cortical awareness and evaluation occur.

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82. (B) Blood-brain barrier
The blood-brain barrier is a highly selective semipermeable membrane boundary formed by specialized brain capillary endothelial cells with tight junctions and supporting astrocytic foot processes. It strictly regulates the entrance of circulating substances, shielding brain tissue from circulating pathogens, toxins, bacteria, and abrupt biochemical fluctuations present in the blood.

83. (C) Neurons
Neurons are the fundamental structural and functional cellular units of the nervous system. Highly specialized for transmitting bioelectrical and chemical signals, neurons consist of a cell body, dendrites, and an elongated axon, forming vast neural networks that process sensory information, formulate decisions, and execute precise physical motor actions.

84. (D) Catching a moving ball
Catching a moving ball requires continuous visual tracking by the eyes, rapid spatial coordinate processing within the visual and motor areas of the forebrain, and fine motor signal relay via the cerebellum to arm muscles. This complex real-time motor action relies on seamless integration between sense organs and the brain.

85. (A) Eyes → Forebrain → Motor nerves → Arm muscles
Visual sensory receptors in the eyes convert light signals into electrical impulses transmitted along optic nerves to sensory processing centers in the forebrain. The cerebral cortex interprets the object's position, formulates a voluntary plan, and sends motor impulses down motor pathways to actuate arm skeletal muscles to reach out.

86. (C) Seek medical supervision for seizure management
Managing epilepsy effectively requires ongoing medical evaluation, diagnostic testing like electroencephalograms, and consistent administration of prescribed anti-epileptic medications. Proper medical oversight controls abnormal cerebral electrical activity, significantly reduces the frequency and severity of unprovoked seizures, and safeguards the patient's long-term physical health and brain function.

87. (B) A stroke cutting off cerebral blood supply
Paralysis frequently results from an ischemic or hemorrhagic stroke, where blood flow to specific cerebral motor regions is severely compromised. Deprived of oxygen and metabolic nutrients, central motor neurons die or suffer severe functional damage, blocking signal transmission along corticospinal tracts and causing loss of voluntary muscle control.

88. (A) It expands cerebral surface area for neurons.
The extensive folding of the outer cerebral cortex into ridges called gyri and grooves called sulci significantly expands the available cortical surface area. This anatomical convolution accommodates billions of additional neuronal cell bodies within the compact cranial space, facilitating complex neural processing, enhanced memory capacity, and advanced intellectual reasoning.

89. (C) Cerebrum
Attempting to recall specific factual information activates neural retrieval networks in the cerebrum. Conscious thinking, active problem-solving, intellectual reasoning, and memory retrieval are managed by the prefrontal cortex, hippocampus, and surrounding association areas situated within the expanded cerebral cortex of the forebrain.

90. (A) Immediate improvement in vision
Severe traumatic head injuries disrupt normal brain physiology, producing immediate pathological symptoms like sudden loss of consciousness, memory confusion, nausea, vomiting, dizziness, or focal visual deficits. Severe blunt trauma to delicate neural structures damages delicate brain tissue, causing impaired visual function rather than visual improvement.

91. (B) Decreased water content in body fluids
Specialized osmoreceptor neurons located within the hypothalamus continuously monitor the solute concentration and fluid osmolarity of circulating blood. When body water levels drop, increased osmolarity triggers hypothalamic thirst centers, initiating the conscious sensation of thirst to stimulate fluid intake and restore internal osmotic equilibrium.

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is the neuron. Neurons are highly specialized conductive cells designed to generate, process, and transmit electrical action potentials and chemical neurotransmitter signals across intricate neural circuits, coordinating physical sensations, thoughts, and physical actions.

113. (C) Synapse
The specialized junction separating adjacent neurons or connecting a neuron to an effector cell is called a synapse. When an electrical action potential reaches the presynaptic terminal, it triggers the exocytosis of chemical neurotransmitters across the narrow synaptic cleft, binding to postsynaptic membrane receptors to transmit signals.

114. (B) Images soft tissues clearly without X-rays
Magnetic Resonance Imaging is an advanced diagnostic imaging modality preferred for evaluating soft tissue structures like the brain. By utilizing powerful magnetic fields and high-frequency radio waves rather than ionizing X-ray radiation, MRI provides high-contrast cross-sectional images that clearly distinguish brain parenchyma, white matter tracts, lesions, and soft tissues.

115. (A) II, IV, I, III
Executing a voluntary task like writing begins with decision formulation in the forebrain's motor cortex. Descending motor signals travel down nerve tracts through the spinal cord, exit along motor spinal neurons, and arrive at hand skeletal muscle effectors to stimulate precise motor contractions necessary to maneuver a pen.

116. (D) It can function for hours without oxygen.
Human brain tissue is extraordinarily sensitive to oxygen deprivation due to its continuous high metabolic activity and lack of internal glycogen or oxygen stores. Interruption of cerebral oxygen delivery for just a few minutes causes irreversible neuronal cell death, brain damage, and total functional breakdown, making prolonged oxygen deprivation fatal.

117. (B) Humans possess vast language and abstract memory capacity.
Human memory capabilities are distinctly set apart from lower animals by an enormously expanded cerebral cortex that supports abstract reasoning, symbolic language encoding, complex conceptual learning, and autobiographical memory retrieval, enabling humans to store, organize, and consciously recall vast volumes of structured information over long durations.

118. (A) They surround only the brain, not the spinal cord.
The meninges are continuous protective connective tissue membranes that enclose both the brain within the cranium and the spinal cord extending through the vertebral column. Inflammation of these protective meningeal layers by viral or bacterial pathogens causes meningitis, a severe neurological medical condition affecting the entire central nervous system.

119. (C) A voluntary action controlled by the brain
Physical walking is a voluntary movement controlled and coordinated by motor areas of the brain, including the cerebral cortex and cerebellum. Unlike rapid involuntary spinal reflexes that occur automatically without conscious thought, walking requires deliberate cognitive intent, ongoing sensory balance integration, and continuous voluntary motor commands sent to muscles.

120. (B) It requires conscious learning and practice.
Behaviors governed by the cerebrum are distinguished by conscious intent, cognitive processing, active learning, and voluntary motor execution. Complex acquired skills such as writing, reading, playing musical instruments, or solving mathematical equations depend directly on extensive neural processing, memory consolidation, and conscious decision-making within the outer cerebral cortex.

121. (D) Medulla and Pons
Pulmonary ventilation during sleep is maintained by autonomic respiratory centers situated within the medulla oblongata and the pons in the hindbrain. These brainstem structures continuously sense arterial carbon dioxide levels and blood pH, generating automatic electrical nerve signals that contract respiratory muscles to maintain continuous breathing without conscious cortical input.

122. (C) Stroke
A stroke occurs when cerebral blood supply is suddenly interrupted due to an arterial blockage or internal blood vessel rupture. This acute restriction deprives downstream brain cells of essential molecular oxygen and glucose,

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inside the skull cavity. This traumatic shearing force disrupts normal bioelectrical neural signaling, causes transient widespread neuronal depolarization, and temporarily compromises functional brainstem networks, resulting in an immediate, temporary loss of conscious awareness.

165. (A) II, I, IV, III, V
A reflex arc operates through a precise chronological sequence. First, a sensory receptor detects an external environmental stimulus. A sensory neuron then transmits electrical impulses into the spinal cord for rapid signal processing. Finally, a motor neuron conveys descending motor commands directly to an effector muscle, triggering an immediate physical response.

166. (B) EEG
An electroencephalogram is the primary non-invasive diagnostic test used to evaluate patients suspected of having epilepsy. By placing electrodes across the scalp, the EEG records continuous cortical bioelectrical activity, enabling neurologists to detect characteristic spike-and-wave patterns and localized electrical discharges diagnostic of epileptic seizure disorders.

167. (B) To support higher cognition, language, and reasoning
Humans possess a disproportionately large forebrain and expanded cerebral cortex compared to other species. This evolutionary expansion accommodates massive neural networks dedicated to high-level cognitive capabilities, including abstract reasoning, symbolic language comprehension, logical problem-solving, long-term planning, social communication, and voluntary fine motor processing.

168. (C) Hypothalamus
The hypothalamus is the primary regulatory center governing basic physiological drives, including hunger, satiety, and thirst. Specialized hypothalamic neural nuclei monitor circulating nutrient concentrations, gastrointestinal satiety hormones, and blood osmolarity levels, initiating conscious feelings of hunger or thirst to direct behavioral food and fluid intake for homeostatic balance.

169. (B) It acts as a rigid, protective outer skull shell.
The skull, specifically the cranium, serves as a rigid, protective bony shell surrounding the delicate soft tissue of the human brain. Composed of fused cranial bones, it absorbs external mechanical forces, wards off physical impacts, and shields underlying central nervous structures, blood vessels, and membranes from traumatic physical injuries.

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170. (C) Paralysis of the body below the neck
Severing the spinal cord in the cervical neck region permanently severs ascending sensory and descending motor pathways connecting the brain to the rest of the body. This catastrophic structural disruption prevents motor impulses from reaching skeletal muscles, causing complete loss of voluntary movement and sensation below the neck level, termed quadriplegia.

171. (C) Epilepsy
Epilepsy is a chronic neurological condition characterized by spontaneous, unprovoked seizures caused by abnormal, excessive electrical discharges in brain neural circuits. These abnormal electrical bursts disrupt normal neurological communication, producing temporary involuntary muscle spasms, sensory distortions, behavioral alterations, or loss of conscious awareness during seizure episodes.

172. (B) Neuron cell bodies
Grey matter in the central nervous system consists primarily of unmyelinated structures, including neuronal cell bodies, dendrites, synaptic connections, neuroglial cells, and capillaries. This high density of metabolic cell bodies gives the tissue its characteristic grey appearance, distinguishing it from white matter, which is composed mainly of myelinated nerve fibers.

173. (B) MRI uses a magnetic field; CT scan uses X-rays.
The primary difference between Magnetic Resonance Imaging and Computed Tomography lies in their underlying imaging physics. MRI utilizes powerful magnetic fields and radio waves to generate detailed high-contrast images of soft brain tissues without radiation, whereas CT scanning uses rotating ionizing X-ray beams to image cranial bones and soft tissue structures.

174. (A) Cerebral memory formation
Retaining factual information and recalling it during an examination relies on cerebral memory processing. Factual information is encoded,

133. (C) Pituitary
The pituitary gland is frequently designated as the body's master endocrine gland because its secretions regulate numerous peripheral endocrine glands. However, the pituitary gland itself is directly controlled by the overlying hypothalamus, which releases specialized neurohormones to govern pituitary endocrine hormone synthesis and secretion into circulation.

134. (D) Coordinating overall bodily functions
The primary function of the brain is to serve as the master control and integration center of the body. It processes incoming sensory information, regulates both voluntary movements and involuntary autonomic processes, manages hormonal homeostasis via the endocrine system, and facilitates high-level cognition, memory, and emotional responses.

135. (C) Assertion (A) is true but Reason (R) is false.
The human cerebrum exhibits a heavily folded outer cerebral cortex, containing numerous gyri and sulci that dramatically increase available surface area. This expanded surface area allows the brain to accommodate significantly more neurons within the limited cranial cavity, enhancing cognitive capacity rather than reducing neuron numbers.

136. (B) Cerebrum
Learning and mastering a new language involves complex cognitive processes including symbolic comprehension, memory storage, grammar analysis, and motor speech planning. These sophisticated intellectual functions are governed exclusively by specialized association zones within the cerebral cortex of the forebrain, including Broca's area and Wernicke's area in the cerebrum.

137. (D) Corpus callosum - Fluid inside the skull
The corpus callosum is a thick, transverse band of white matter nerve fibers that physically connects the left and right cerebral hemispheres, facilitating interhemispheric communication. It is not a fluid. Protection for the brain is provided by the bony cranium, fibrous meninges, and circulating shock-absorbing cerebrospinal fluid.

138. (A) Forebrain
Integrating incoming sensory data with stored past experiences to make logical decisions is a cognitive capability governed by the forebrain. The cerebral cortex analyzes sensory inputs, accesses long-term memory networks, performs abstract reasoning, and formulates appropriate voluntary behavioral plans before executing actions through motor output pathways.

139. (C) Mental health disorders such as anxiety or depression
Sustained emotional or mental stress leads to chronic elevation of stress hormones like cortisol, which damages delicate neural networks in the hippocampus and prefrontal cortex. This chronic biochemical imbalance impairs neuroplasticity, disrupts neurotransmitter regulation, and significantly increases the clinical risk of developing mental health disorders such as anxiety or major depression.

140. (A) P-3, Q-4, R-1, S-2
Functional regions within the brain process specific physiological operations. The occipital region handles visual interpretation. The temporal region processes auditory sensory input. Cerebral motor areas initiate voluntary muscle movements, while the lower medulla oblongata contains autonomic control centers responsible for maintaining continuous, automatic pulmonary breathing rhythms.

141. (C) Smell
The olfactory lobes are specialized forebrain structures dedicated to processing chemical odor signals. Nasal olfactory receptors convert chemical scent molecules into electrical impulses, which travel along olfactory nerves directly to the olfactory lobes for sensory processing, enabling the conscious identification, discrimination, and interpretation of distinct environmental smells.

142. (D) Respiration
A severe impact to the lower rear base of the skull risks damaging the underlying medulla oblongata. Because the medulla houses vital autonomic cardiorespiratory centers that automatically regulate breathing rhythms and heart rate, structural injury to this region can instantly cause respiratory arrest, cardiac failure, and fatal complications.

143. (B) Digesting a meal
Gastrointestinal digestion is an automatic involuntary physiological process controlled by the autonomic nervous system and enteric neural pathways without conscious cortical involvement.

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causing rapid ischemic tissue injury, cell death, and abrupt neurological deficits like localized paralysis or speech loss.

123. (A) Relay station for sensory and motor signals
Positioned within the diencephalon of the forebrain, the thalamus functions as a critical central sensory and motor relay station. It collects incoming sensory inputs from all sense organs, except smell, filters and processes these signals, and routes them accurately to specialized functional processing regions across the cerebral cortex.

124. (D) Limbic system and hypothalamic areas of the forebrain
Emotional responses such as fear, anger, pleasure, and motivation are primarily governed by the limbic system, an interconnected network of forebrain structures including the amygdala, hippocampus, and hypothalamus. These integrated neural circuits process emotional stimuli, regulate autonomic responses, and associate emotional states with contextual memory formation.

125. (B) Medulla, Pons, Midbrain, Cerebrum
Moving vertically upward along the central nervous system axis from the spinal cord boundary, the basic structural division begins with the medulla oblongata, ascends through the pons, passes through the midbrain, and culminates in the overlying expanded cerebral hemispheres that constitute the human cerebrum.

126. (D) Spinal cord
Tapping the patellar tendon stretches quadriceps muscle receptors, sending sensory signals along afferent nerves into the lumbar region of the spinal cord. Interneurons immediately transmit motor signals back to lower leg muscles, causing a knee-jerk reflex kick. This rapid monosynaptic involuntary reflex is processed completely within the spinal cord.

127. (A) Epilepsy
Epilepsy is a chronic neurological disorder characterized by recurrent, unprovoked seizures caused by abnormal, excessive, and hypersynchronized electrical activity among brain neurons. These sudden electrical surges disrupt normal bioelectrical communication across neural networks, manifesting as temporary motor convulsions, sensory disruptions, or loss of conscious awareness.

128. (B) To provide buoyancy and absorb mechanical shocks
Cerebrospinal fluid is essential because it bathes the delicate brain and spinal cord within a fluid cushion. This fluid offers mechanical shock absorption during sudden impacts, provides hydraulic buoyancy that reduces effective brain mass, maintains intracranial pressure balance, and facilitates metabolic nutrient delivery and waste removal from neural tissue.

129. (D) Walking smoothly and maintaining physical balance
The cerebellum is the brain center responsible for motor coordination, posture control, and physical balance. If an animal's cerebellum is damaged, it loses fine voluntary motor coordination, leading to severe ataxia, an unsteady staggering gait, physical imbalance, and an inability to execute smooth, controlled muscular movements.

130. (B) Rigid interlocking flat cranial bones
The cranium, or skull cap, is composed of strong, rigid interlocking flat bones joined together by immovable fibrous joints called sutures. These durable cranial bones form a protective skeletal helmet surrounding the delicate brain, shielding soft central nervous tissue from physical trauma and external mechanical injury.

131. (C) The brain's capacity to form new neural connections
Neuroplasticity refers to the intrinsic capacity of the central nervous system to modify its structural organization and functional pathways throughout an individual's lifetime. Through neuroplastic mechanisms, brain neurons continually adapt to new learning, environmental changes, physical experiences, or functional reorganization following structural brain injury.

132. (C) MRI
Magnetic Resonance Imaging is a non-invasive diagnostic medical imaging technique that utilizes powerful magnetic fields and high-frequency radio waves. It excites hydrogen protons within body tissues to generate highly detailed, high-contrast cross-sectional images of soft internal structures like the brain without exposing patients to ionizing radiation.

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from friction, shearing forces, and structural damage during physical head movements.

154. (B) Hindbrain
The midbrain is the central brainstem region positioned between the forebrain above and the hindbrain below. It serves as an essential physical and functional junction, housing ascending and descending nerve fiber tracts alongside neural nuclei that coordinate visual and auditory reflexes, relaying signals seamlessly between upper forebrain and lower hindbrain structures.

155. (C) III only
The spinal cord extends directly from the base of the medulla oblongata and acts as the primary processing center for spinal reflex actions. However, the spinal cord is housed and protected by the bony vertebral column, not the cranium, which specifically encloses the brain, making the third statement incorrect.

156. (C) Salivating when seeing food
Conscious logical thinking, long-term memory retrieval, and solving complex mathematical problems are high-level voluntary cognitive processes controlled by the cerebral cortex within the forebrain. Salivating upon seeing food, however, is an automatic involuntary autonomic reflex mediated by lower brainstem structures, making it functionally distinct from conscious cognitive tasks.

157. (B) CT Scan
Computed Tomography scanning is a specialized diagnostic imaging technique that utilizes a series of narrow X-ray beams rotated around the patient's head. Advanced computer algorithms process these multiple X-ray attenuation measurements to create detailed cross-sectional tomographic slice images of internal skull bones, vascular structures, and brain tissue.

158. (C) It bathes the brain and spinal cord.
Cerebrospinal fluid is a clear, colorless liquid that fills the ventricular system and subarachnoid space, continuously bathing both the brain and spinal cord. It provides essential mechanical shock absorption, maintains neural tissue buoyancy, regulates intracranial pressure, and transports essential metabolic nutrients while removing cellular metabolic waste products.

159. (D) Muscles and glands
In neural control pathways, effectors are specialized responsive organs that execute bodily actions mandated by motor signals sent from the central nervous system. Skeletal, smooth, and cardiac muscles act as motor effectors by contracting, while exocrine and endocrine glands act as secretor effectors by releasing specific chemical substances or hormones.

160. (D) Sudden increase in hair growth
Acute strokes present with sudden neurological deficits caused by interrupted cerebral blood flow, including facial numbness, limb weakness, sudden speech impairment, confusion, and loss of physical balance or vision. Biological hair growth, however, is governed by follicular cellular cycles and metabolic hormones, remaining entirely unrelated to acute stroke pathology.

161. (C) Stroke
A stroke occurs when cerebral blood supply is severely reduced or interrupted by an arterial clot or vascular rupture. Starved of oxygen and essential metabolic glucose, affected brain cells rapidly undergo irreversible ischemic cell death, leading to localized functional losses such as facial drooping, localized paralysis, or loss of speech.

162. (A) Medulla signals lungs to breathe faster.
When arterial blood carbon dioxide levels rise, central chemoreceptors located in the medulla oblongata detect the resulting drop in blood pH. The medulla responds by increasing the frequency of nerve signals sent to respiratory muscles, accelerating pulmonary ventilation rate to exhale excess carbon dioxide and restore proper blood gas balance.

163. (B) Cerebellum
Playing complex musical compositions on a piano demands rapid, highly accurate finger movements and fine motor control. The cerebellum is the primary brain center responsible for coordinating complex voluntary muscle contractions, regulating fine movement precision, timing motor patterns, and maintaining spatial muscle balance during delicate physical tasks like playing instruments.

164. (B) Disruption of normal brain electrical activity
A severe mechanical impact to the head causes rapid physical displacement of brain tissue

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CHAPTER 07

Coordination in Plants

1. Which of the following best describes the method of coordination in plants?
(A) Through chemical messengers called hormones
(B) Through a complex nervous system
(C) Through muscle contraction and relaxation
(D) Through a specialized circulatory system

2. Unlike animals, plants do not have a nervous system. How do plants respond to environmental stimuli?
(A) By using specialized sensory nerves
(B) By rapid muscle movements
(C) By changing growth patterns using hormones
(D) By generating electrical impulses in the brain

3. What is the general term used for the chemical substances that regulate growth and development in plants?
(A) Phytohormones
(B) Enzymes
(C) Neurotransmitters
(D) Antibodies

4. Which of the following is not a recognized plant hormone?
(A) Auxin
(B) Gibberellin
(C) Cytokinin
(D) Thyroxine

5. Where is the hormone auxin primarily synthesized in a plant?
(A) In the mature leaves
(B) At the shoot tip
(C) In the old branches
(D) In the xylem vessels

6. Which plant hormone is primarily responsible for cell elongation in the growing shoot?
(A) Cytokinin
(B) Abscisic acid
(C) Auxin
(D) Ethylene

7. How does auxin respond when light comes from only one side of the plant?
(A) It diffuses towards the sunny side of the shoot.
(B) It is destroyed by the light immediately.
(C) It moves down to the roots to escape the light.
(D) It diffuses towards the shady side of the shoot.

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8. The diffusion of auxin to the shaded side of a stem causes the cells on that side to grow longer. What is the visible result of this process?
(A) The plant bends towards the light.
(B) The plant bends away from the light.
(C) The plant stops growing entirely.
(D) The stem becomes thicker and shorter.

9. Which of the following is a major function of gibberellins in plants?
(A) Inhibiting plant growth
(B) Helping in the growth of the stem
(C) Promoting cell division in aging leaves
(D) Causing the wilting of leaves

10. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Gibberellins are applied to agricultural crops to break seed dormancy.
Reason (R): Gibberellins act as growth inhibitors that keep the seed in a resting state.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

11. Which plant hormone is specifically known to promote rapid cell division?
(A) Cytokinin
(B) Auxin
(C) Abscisic acid
(D) Ethylene

consolidated, and retrieved through dynamic synaptic changes across interconnected neural networks located within the cerebral cortex and associated limbic structures, facilitating conscious intellectual recall and academic problem-solving performance.

175. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
The human brain is extraordinarily vulnerable to oxygen deprivation because neurons possess extremely high metabolic energy demands yet maintain virtually no internal stores of glycogen or oxygen. Interruption of arterial blood flow starves brain cells of essential metabolic substrate, causing rapid aerobic metabolic failure and irreversible neuronal cell death within minutes.

176. (B) Medulla
Even during deep comatose states, the medulla oblongata remains functional within the lower brainstem. It contains fundamental, autonomous cardiorespiratory and vasomotor control centers that continuously generate automatic electrical signals to maintain vital pulmonary breathing rhythms, regulate cardiac beating, and sustain basic circulatory blood pressure necessary for biological survival.

177. (C) Brain, spinal cord, and network of nerves
The human nervous system is anatomically divided into the central nervous system, comprising the brain and spinal cord, and the peripheral nervous system, consisting of cranial and spinal nerve networks. Together, these integrated divisions collect sensory information, perform complex signal processing, and transmit motor commands throughout the entire body.

178. (C) It is severely impaired, hindering learning.
Sleep deprivation severely disrupts normal cognitive function and memory consolidation. Adequate sleep stages are essential for stabilizing newly formed synaptic connections made during daytime learning. Chronic lack of rest prevents the transfer of fragile short-term memories into stable long-term cerebral cortical storage, significantly impairing learning retention and cognitive recall.

179. (B) Spinal cord
Touching a sharp pin triggers a rapid involuntary withdrawal reflex mediated directly by the spinal cord. Sensory pain receptors send electrical impulses along afferent fibers into the grey matter of the spinal cord, where interneurons immediately excite motor neurons to contract arm withdrawal muscles before sensory signals reach the conscious brain.

180. (A) P-3, Q-4, R-1, S-2
Neurological activities map directly to specialized brain structures. Maintaining tightrope balance depends on cerebellar motor coordination. The feeling of hunger is governed by hypothalamic metabolic centers. Mathematical reasoning and abstract thinking are processed in the cerebrum, while involuntary respiratory reflexes like sneezing are managed by the medulla oblongata.

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181. (C) Hypothalamic circadian centers
Internal circadian rhythms and 24-hour sleep-wake cycles are primarily governed by specialized circadian centers situated within the hypothalamus, notably the suprachiasmatic nucleus. Receiving direct light inputs from optic pathways, this hypothalamic clock coordinates daily metabolic rhythms, core body temperature variations, and cyclic pineal melatonin secretion driving sleep patterns.

182. (B) Cerebrum
Retrograde memory loss and an inability to form new long-term memories indicate damage to cerebral structures, particularly the cerebral cortex and associated temporal limbic regions like the hippocampus. The cerebrum is the primary brain center responsible for processing, consolidating, retaining, and consciously retrieving declarative memories, factual knowledge, and life experiences.

183. (D) It carries oxygen like red blood cells.
Cerebrospinal fluid is a clear, acellular fluid that bathes central nervous system structures to provide mechanical cushioning, hydraulic buoyancy, and metabolic waste removal. It does not contain hemoglobin or red blood cells and does not serve as an oxygen carrier; systemic oxygen transport is strictly performed by hemoglobin in red blood cells.

184. (B) Hypothalamus
Biological integration between the rapid bioelectrical nervous system and the humoral endocrine system is controlled primarily by the hypothalamus. Located at the forebrain base,

the hypothalamus continuously monitors neural signals and internal physiological parameters, synthesizing neurohormones that directly regulate pituitary gland secretions to maintain overall body homeostasis.

185. (B) I and II only
The human brain is safely housed within the protective bony cranium and depends on continuous blood flow to deliver necessary oxygen and glucose. However, the brain constantly receives and processes diverse sensory inputs from sense organs, making the third statement factually incorrect regarding basic central nervous system functional processing.

186. (C) Larger size and complexity of the cerebral cortex
The human brain is distinguished from other primate brains primarily by the massive evolutionary enlargement and structural complexity of its cerebral cortex. This highly convoluted outer layer contains expanded association areas that facilitate superior abstract reasoning, symbolic language processing, complex problem-solving, long-term future planning, and highly refined voluntary motor control.

187. (B) Electrical activity of brain neurons
An electroencephalogram measures and records bioelectrical signals generated by populations of active brain neurons. Electrodes attached to the scalp detect microvolt potential changes produced by synchronized synaptic firing across the cerebral cortex, providing clinicians with valuable real-time diagnostic data regarding brain wave patterns, sleep stages, and seizure disorders.

188. (C) Spinal cord
The central nervous system consists of two main anatomical structures: the brain and the spinal cord. While the brain is entirely housed within the protective cranial cavity of the skull, the spinal cord extends downward outside the cranium, traversing the protective vertebral canal along the back of the body.

189. (B) Pons
The pons is a vital hindbrain structure situated directly superior to the medulla oblongata. Composed largely of transverse nerve fiber tracts, it serves as a major neural bridge relaying sensory and motor signals between the higher cerebral cortex, the underlying cerebellum, and the spinal cord to coordinate motor functions.

190. (B) I, III, and IV only
Protective helmets prevent skull fractures, adequate sleep consolidates memories, and strokes stem from interrupted blood supply. However, chronic stress impairs rather than improves memory by damaging delicate hippocampal connections with elevated cortisol levels, making the second statement false regarding physiological impact on long-term memory health.

191. (A) Clear soft tissue imaging without radiation
Magnetic Resonance Imaging is selected over Computed Tomography primarily because it provides superior contrast resolution when visualizing soft central nervous tissue, brain parenchyma, and white matter tracts. Furthermore, MRI utilizes magnetic fields and radio waves, completely eliminating patient exposure to ionizing X-ray radiation associated with CT scans.

192. (C) Choosing a pen to write
Selecting a pen to write is an entirely voluntary action driven by conscious thought, intentional decision-making, and active motor commands originating within the cerebral cortex. Conversely, pupil dilation in darkness, protein digestion in the stomach, and cardiac heart beating are automatic involuntary autonomic actions managed without conscious intervention.

193. (B) Motor signal pathways to muscles are severed.
Paralysis resulting from severe spinal cord injury occurs because the structural continuity of descending motor nerve pathways is disrupted. Severing these spinal corticospinal tracts blocks descending bioelectrical action potentials sent from the cerebral motor cortex, preventing nerve impulses from reaching peripheral effector muscles, resulting in loss of voluntary movement.

194. (B) Stress and chemical imbalances
Mental health disorders are increasingly linked to altered neurobiology caused by chronic stress and imbalances among key neurotransmitters like serotonin, dopamine, and norepinephrine. Prolonged elevation of stress hormones alters neural architecture, impairs neuroplasticity in mood-regulating circuits, and contributes

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directly to conditions such as clinical depression and anxiety.

195. (C) III only
Involuntary actions operate automatically without conscious intervention and are governed largely by lower brain centers in the hindbrain and midbrain. Writing a letter, however, is a deliberate voluntary physical activity requiring conscious cognitive planning and intentional motor execution by the cerebrum, making the third statement incorrect.

196. (B) Neural tube
Embryonic development of the central nervous system initiates with the formation of the neural tube along the dorsal ectoderm. This hollow neural structure serves as the fundamental anatomical precursor, subsequently swelling and differentiating at its anterior end to form the primary forebrain, midbrain, and hindbrain regions, while the posterior portion forms the elongated spinal cord.

197. (D) Medulla
The cerebrum, thalamus, and hypothalamus are integrated structural components belonging to the forebrain division. Conversely, the medulla oblongata is an anatomically distinct structure located in the lower hindbrain, containing vital autonomic control centers for respiration and heart rate, making it functionally and structurally distinct from the listed forebrain structures.

198. (B) II, III, and IV
Anatomically, the human brain is partitioned into three major developmental divisions: the forebrain, midbrain, and hindbrain. The hindbrain is specifically composed of three interconnected structures located at the base of the skull: the cerebellum, the pons, and the medulla oblongata. The cerebrum, conversely, is the primary constituent of the forebrain.

199. (C) Bony vertebral column
Just as the brain is surrounded and protected by the rigid bones of the cranium, the spinal cord is shielded by the bony vertebral column. Composed of individual interlocking vertebrae, this flexible skeletal column encloses the spinal canal, shielding delicate central nervous tissue from physical trauma, impact forces, and mechanical injury.

200. (B) The brain
The brain is the ultimate command and integration center of the human body. It continuously processes incoming sensory information, governs complex cognitive thoughts, stores memories, regulates emotional responses, manages homeostatic endocrine outputs, and coordinates both automatic involuntary autonomic functions and intentional voluntary motor actions that dictate human behavior.

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Conversely, activities like reading a book, playing chess, or painting require active, intentional conscious cognitive processing managed by the cerebral cortex within the forebrain.

144. (D) Facilitates memory consolidation and neural repair
Sleep is an essential neurobiological process during which the brain undergoes critical functional restoration. Active sleep stages allow neural networks to consolidate short-term memories into stable long-term storage, clear accumulated metabolic waste products through the glymphatic system, repair cellular damage, and restore biochemical equilibrium necessary for optimal daytime cognitive function.

145. (A) I and II only
Head injuries can disrupt delicate neural memory circuits in the cerebrum, resulting in permanent memory loss, while safety helmets provide essential mechanical protection to the rigid skull. However, head injuries do not always result in immediate death, as many individuals recover depending on injury severity, making the third statement incorrect.

146. (B) Motor cortex and cerebellum areas
Articulate speech requires precise, synchronized motor coordination of the tongue, lips, vocal cords, and larynx. Motor regions within the cerebral cortex, specifically Broca's area, formulate and initiate motor commands, while the cerebellum continuously fine-tunes muscle timing and precision, producing clear, fluid vocal pronunciation during speech production.

147. (C) Protect them from injury while seizure resolves
When an individual experiences an epileptic seizure, bystander intervention should focus on keeping the person safe from physical trauma. Restraining limbs forcefully or placing objects into the mouth can cause severe musculoskeletal or dental injuries. The safest protocol involves clearing hazardous objects away and protecting the individual until the seizure resolves naturally.

148. (A) Adequate sleep and balanced diet
Maintaining optimal long-term brain health requires healthy lifestyle practices, including obtaining adequate restful sleep and consuming a balanced, nutrient-rich diet. Proper nutrition provides glucose and essential fatty acids for neuronal metabolism, while adequate sleep facilitates waste clearance, neural repair, and effective memory consolidation across central nervous pathways.

149. (C) Loss of voluntary muscle movement in body parts
Paralysis is clinically defined as the loss of voluntary muscle function in one or more parts of the body. It occurs when neural communication along motor pathways between the brain, spinal cord, and peripheral skeletal muscles is damaged or interrupted by trauma, stroke, nerve compression, or neurodegenerative diseases.

150. (B) I, II, and IV only
Human motor control is contralateral, meaning the left cerebral hemisphere controls the right side of the body, while the right hemisphere controls the left side, and the hypothalamus governs pituitary gland function. However, involuntary coughing reflexes are managed by the medulla oblongata, not the cerebrum, making statement three false.

151. (C) Frontal areas of the cerebrum
The prefrontal cortex, located in the frontal regions of the cerebrum, is the primary brain center for governing human personality, social behavior, impulse control, decision-making, and emotional regulation. Structural damage to this specific cerebral area can dramatically alter an individual's personal traits, emotional responses, and social conduct.

152. (A) Hypothalamus
When a sudden physical threat or emergency is perceived, the hypothalamus initiates a rapid stress response. It activates the sympathetic nervous system, sending descending neural signals down the spinal cord to stimulate the adrenal medulla, triggering the immediate release of adrenaline into blood circulation to mobilize the fight-or-flight mechanism.

153. (D) The protective meninges and cerebrospinal fluid
The brain is physically separated from direct contact with the interior surface of the bony skull by three fibrous meningeal membranes—the dura, arachnoid, and pia mater—alongside surrounding cerebrospinal fluid. This cushioned liquid boundary shields delicate neural tissue

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12. In which of the following plant parts would you expect to find the highest concentration of cytokinins?
(A) Old bark
(B) Wilting leaves
(C) Fruits and seeds
(D) Dead woody tissues

13. Which plant hormone plays a major role in delaying the aging of leaves and keeping them green?
(A) Abscisic acid
(B) Ethylene
(C) Gibberellin
(D) Cytokinin

14. Abscisic acid is generally categorized as which type of hormone?
(A) Growth promoter
(B) Flowering stimulant
(C) Growth inhibitor
(D) Fruit ripening agent

15. Consider the following statements regarding Abscisic acid (ABA):
I. It promotes the wilting of leaves.
II. It helps in increasing stem elongation.
III. It acts as a stress hormone during water scarcity.
Which of the above statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

16. The falling of older leaves and ripe fruits from the tree is primarily promoted by which hormone?
(A) Auxin
(B) Gibberellin
(C) Abscisic acid
(D) Cytokinin

17. Which of the following plant hormones is uniquely found in a gaseous state at normal room temperature?
(A) Ethylene
(B) Auxin
(C) Cytokinin
(D) Gibberellin

18. What is the most well-known function of the ethylene hormone in plants?
(A) Causing seed germination
(B) Promoting rapid cell division
(C) Promoting fruit ripening
(D) Increasing root length

19. A directional growth movement of a plant part in response to an external stimulus is called:
(A) Nastic movement
(B) Turgor movement
(C) Reflex action
(D) Tropic movement

20. When a plant organ grows in the direction of the stimulus, the tropism is termed as:
(A) Positive tropism
(B) Negative tropism
(C) Neutral tropism
(D) Nastic response

21. Phototropism is defined as the directional movement of a plant part in response to:
(A) Gravity
(B) Water
(C) Light
(D) Chemicals

22. In standard phototropism, how do the shoots and roots of a plant generally behave?
(A) Shoots are negatively phototropic; roots are positively phototropic.
(B) Both shoots and roots are positively phototropic.
(C) Both shoots and roots are negatively phototropic.
(D) Shoots are positively phototropic; roots are negatively phototropic.

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23. What is the term for the downward growth of plant roots in response to the pull of gravity?
(A) Positive geotropism
(B) Negative phototropism
(C) Positive hydrotropism
(D) Negative geotropism

24. Which part of the plant typically exhibits negative geotropism?
(A) Primary root
(B) Shoot system
(C) Secondary roots
(D) Root hairs

25. Consider the following statements regarding tropic movements:
I. Phototropism is response to light.
II. Geotropism is response to gravity.
III. Hydrotropism is response to touch.
IV. Chemotropism is response to chemicals.
Which of the above statements is/are correct?

(A) I, II, and III
(B) II, III, and IV
(C) I, II, and IV
(D) I, III, and IV

26. Hydrotropism refers to the directional growth of plant roots towards which stimulus?
(A) Nutrients
(B) Gravity
(C) Water
(D) Light

27. If a plant is grown in a pot where water is present only on one side of the soil, the roots will bend towards the water. This phenomenon demonstrates:
(A) Phototropism
(B) Thigmotropism
(C) Nastic movement
(D) Hydrotropism

28. Which of the following tropisms explains how a pollen tube grows down the style towards the ovule during fertilization?
(A) Chemotropism
(B) Hydrotropism
(C) Geotropism
(D) Phototropism

29. Chemotropism is defined as the directional growth of a plant part in response to:
(A) Temperature changes
(B) Chemical stimuli
(C) Mechanical touch
(D) Magnetic fields

30. The climbing movement of tendrils in vine plants when they come into contact with a solid support is an example of:
(A) Phototropism
(B) Geotropism
(C) Thigmotropism
(D) Hydrotropism

31. What is the primary stimulus that triggers a thigmotropic response in plants?
(A) Moisture
(B) Sunlight
(C) Chemical gradients
(D) Touch or contact

32. In thigmotropism of a tendril, how does the growth rate differ across the tendril?
(A) The side away from the support grows faster.
(B) The side in contact with the support grows faster.
(C) Both sides grow at the exact same rate.
(D) Growth stops completely upon contact.

33. Plant movements that are not determined by the direction of the stimulus are known as:
(A) Tropic movements
(B) Nastic movements
(C) Tactic movements
(D) Phototropic movements

34. Which of the following is a classic example of a nastic movement?
(A) Roots growing directionally towards water
(B) Stem bending directionally towards light
(C) Sensitive plant leaves folding upon touch
(D) Coiling of a tendril around a solid support

35. Match the plant hormones in List I with their primary functions in List II.
List I: (Plant Hormones)
P. Auxin
Q. Gibberellin
R. Cytokinin
S. Abscisic acid
List II: (Primary Functions)
1. Inhibits growth and closes stomata
2. Promotes cell division
3. Causes stem elongation
4. Promotes cell elongation on the shaded side
(A) P-3, Q-4, R-1, S-2
(B) P-4, Q-2, R-3, S-1
(C) P-2, Q-3, R-4, S-1
(D) P-4, Q-3, R-2, S-1

36. What is the common name of the sensitive plant (Mimosa pudica) in Hindi?
(A) Chui-mui
(B) Tulsi
(C) Neem
(D) Banyan

37. The rapid folding of leaves in Mimosa pudica is a response to:
(A) Change in light intensity
(B) Presence of chemicals in the soil
(C) Touch stimulus
(D) Gravitational pull

38. Which type of movement is shown by the leaves of Mimosa pudica when touched?
(A) Thigmotropism
(B) Phototropism
(C) Hydrotropism
(D) Seismonasty

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39. Unlike tropic movements, the nastic movement in the sensitive plant is:
(A) Slow and direction-dependent growth
(B) Rapid and independent of direction
(C) Dependent on stimulus direction
(D) A permanent growth-based change

40. The movement of leaves in the sensitive plant is brought about by changes in:
(A) Fluctuations in shoot tip auxin levels
(B) Cellular water loss and turgor changes
(C) Sudden spikes in ethylene gas production
(D) Variations in leaf photosynthetic rate

41. In the sensitive plant, the specialized swollen base of the leaf stalk that loses water to cause folding is called the:
(A) Stomata
(B) Tendril
(C) Node
(D) Pulvinus

42. Which of the following statements about nastic movements is incorrect?
(A) They are independent of the direction of the stimulus.
(B) They are generally faster than tropic movements.
(C) They are always permanent growth movements.
(D) The folding of Mimosa leaves is an example.

43. Why do farmers and horticulturists use artificial plant growth regulators?
(A) To completely replace organic fertilizers in soil
(B) To serve as a direct substitute for water intake
(C) To decrease atmospheric oxygen output by leaves
(D) To regulate growth, flowering, and fruiting

44. Which hormone is often applied artificially to crops to promote uniform flowering and fruit set?
(A) Auxin
(B) Abscisic acid
(C) Ethylene
(D) Ethane

45. Select the correct sequence of events that occurs when a tendril touches a support.
(A) Contact with support → Auxin diffuses to contact side → Contact side grows faster → Tendril bends away
(B) Contact with support → Auxin diffuses to non-contact side → Non-contact side grows faster → Tendril coils around support
(C) Contact with support → Abscisic acid is released → Tendril stops growing → Coiling happens
(D) Contact with support → Water is lost from the cells → Tendril wilts around the support

46. Seed dormancy is a condition where seeds do not germinate even under favorable conditions. Which hormone helps to break seed dormancy?
(A) Abscisic acid
(B) Ethylene
(C) Gibberellin
(D) Cytokinin

47. Which plant hormone works in opposition to gibberellins regarding seed dormancy, by maintaining the dormant state?
(A) Auxin
(B) Cytokinin
(C) Ethylene
(D) Abscisic acid

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48. During the onset of seed germination, the embryo produces hormones that stimulate growth. Which two hormones are primarily involved in promoting this early growth?
(A) Gibberellin and Cytokinin
(B) Abscisic acid and Ethylene gas
(C) Abscisic acid and Auxin hormone
(D) Ethylene gas and Auxin hormone

49. The process of leaf fall in deciduous trees is scientifically known as:
(A) Germination
(B) Abscission
(C) Photoperiodism
(D) Plasmolysis

50. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Ethylene is widely used in agriculture to ripen fruits artificially.
Reason (R): Ethylene is a natural plant hormone that accelerates the biochemical processes of fruit ripening.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

(A) Root hairs
(B) Zone of maturation
(C) Xylem vessels
(D) Root cap

98. In a climbing plant, the tendril is an adaptation for finding support. This shows the plant's sensitivity to:
(A) Touch
(B) Sound
(C) Light
(D) Chemical gradients

99. The coordination in a plant's response to touch in Mimosa pudica is achieved through:
(A) Rapid transmission of specialized nerve impulses
(B) Electro-chemical changes in cellular water content
(C) Slow hormonal diffusion taking place over several days
(D) Rapid contraction of specialized muscular fiber tissues

100. Which cellular property changes to cause the nastic movement in Mimosa pudica?
(A) Cell wall thickness
(B) Nucleus position
(C) Turgor pressure
(D) Chloroplast arrangement

101. Which of the following is NOT an example of a tropic movement?
(A) Root growing towards the center of gravity
(B) Shoot bending towards the sun
(C) Pollen tube growing towards the ovary
(D) Folding of leaves in the sensitive plant

102. What happens to the rate of transpiration when abscisic acid causes stomata to close?
(A) It decreases.
(B) It increases rapidly.
(C) It remains the same.
(D) It stops permanently.

103. Which hormone is widely associated with the breaking of dormancy in buds and seeds during the arrival of spring?
(A) Abscisic acid
(B) Gibberellin
(C) Ethylene
(D) Auxin

104. Which of the following represents a correct pair of a hormone and its primary agricultural use?
(A) Auxin – Promoting artificial fruit ripening in storage
(B) Cytokinin – Serving as a selective agricultural weedicide
(C) Ethylene – Rapidly breaking dormancy in rested seed beds
(D) Gibberellin – Increasing fruit size

105. Consider the following statements regarding plant coordination:
I. It is slower than animal coordination.
II. It relies on chemical messengers.
III. It always involves directional growth.
IV. It helps plants adapt to their environment.
Which of the above statements is/are correct?
(A) I, II, and III
(B) I, II, and IV
(C) II, III, and IV
(D) I, III, and IV

106. A plant's response to gravity is called geotropism. The term "gravitropism" is also commonly used for this. Which plant organ generally shows positive gravitropism?
(A) Root
(B) Leaf
(C) Stem
(D) Flower

107. When a growing seedling is placed in a dark room, it tends to grow extremely tall, pale, and weak. This condition is an attempt by the plant to reach light and is regulated by hormones. What is this condition called?
(A) Plasmolysis
(B) Etiolation
(C) Guttation
(D) Transpiration

108. The directional growth of plant organs in response to the availability of water is termed as:
(A) Chemotropism
(B) Geotropism
(C) Hydrotropism
(D) Phototropism

109. What acts as the receptor for sensing the direction of light in a growing stem?
(A) The root hairs
(B) The mature leaves
(C) The stomata
(D) The shoot tip

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(B) Ethylene
(C) Auxin
(D) Cytokinin

64. A plant stem is placed horizontally on the ground. After a few days, the tip of the stem bends upwards. This shows:
(A) Positive geotropism
(B) Positive hydrotropism
(C) Negative phototropism
(D) Negative geotropism

65. Consider the following statements about plant hormones:
I. Auxin promotes cell elongation.
II. Cytokinin promotes cell division.
III. Gibberellin causes leaf fall.
IV. Abscisic acid promotes seed dormancy.
Which of the above statements is/are correct?
(A) I, II, and III
(B) I, II, and IV
(C) II, III, and IV
(D) I, III, and IV

66. When a seed is placed in moist soil upside down, the root still grows downwards and the shoot grows upwards. This indicates that plants can perceive:
(A) The direction of light only
(B) The direction of gravity
(C) The magnetic field of the earth
(D) The atmospheric pressure

67. How do plants perceive environmental stimuli without sense organs?
(A) Through a complex microscopic nerve network running throughout the stem
(B) Through specialized muscle-like contractile fibers inside leaf tissues
(C) Through cellular receptors and chemical signaling pathways
(D) They cannot perceive environmental stimuli and simply grow randomly

68. Which of the following external factors does NOT directly cause a tropic movement in plants?
(A) Light
(B) Gravity
(C) Chemicals
(D) Wind

69. Some plant hormones are used as weedicides in modern agriculture to clear broad-leaved weeds from cereal crops. Which hormone group do these synthetic weedicides belong to?
(A) Auxins
(B) Ethylene
(C) Cytokinins
(D) Abscisic acid

70. Modern biotechnology makes use of plant hormones in tissue culture. Which two hormones are typically balanced to control root and shoot formation in a callus?
(A) Ethylene and Abscisic acid
(B) Auxin and Cytokinin
(C) Gibberellin and Ethylene
(D) Auxin and Abscisic acid

71. If the tip of a growing seedling is cut off, the plant stops bending towards light. What does this experiment prove?
(A) The tip is the site of water absorption.
(B) The tip produces a hormone required for phototropism.
(C) The tip is the only part that performs photosynthesis.
(D) Cutting the tip introduces a disease.

72. Which type of tissue transports the hormone auxin from the shoot tip to the region of elongation?
(A) Protective outer epidermal tissue layers
(B) Specialized absorbing root hair cells
(C) Microscopic leaf stomatal pore complexes
(D) Phloem and cell-to-cell diffusion

73. Which movement is exhibited by the folding of petals of certain flowers after sunset?
(A) Tropic movement
(B) Nastic movement
(C) Geotropic movement
(D) Hydrotropic movement

74. The movement of plant parts in response to the daily cycle of light and darkness is a type of nastic movement known as:
(A) Thigmonasty
(B) Seismonasty
(C) Hydronasty
(D) Nyctinasty

75. Match the plant movements in List I with their corresponding stimulus in List II.
List I: (Plant Movements)
P. Phototropism
Q. Geotropism
R. Hydrotropism
S. Chemotropism
List II: (Stimulus)

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1. Chemical substance
2. Water
3. Gravity
4. Light

(A) P-4, Q-3, R-2, S-1
(B) P-3, Q-4, R-1, S-2
(C) P-4, Q-2, R-3, S-1
(D) P-1, Q-2, R-3, S-4

76. In an experiment to demonstrate hydrotropism, roots of a seedling grow towards a porous clay pot filled with water, despite the pull of gravity. This shows that:
(A) Geotropism is always stronger than hydrotropism.
(B) Water completely disables the root's ability to sense gravity.
(C) Light is required for roots to find water.
(D) Hydrotropism can override geotropism in root growth.

77. The growth of a pollen tube towards the ovule is guided by chemicals secreted by the:
(A) Ovule
(B) Stigma
(C) Anther
(D) Petals

78. Tendrils of a pea plant demonstrate which specific plant response?
(A) Positive geotropism
(B) Negative phototropism
(C) Positive thigmotropism
(D) Negative chemotropism

79. When a tendril touches a support, why does the side away from the support grow faster?
(A) The non-contact side receives significantly more sunlight
(B) Auxin accumulates on the non-contact side
(C) Gibberellin hormones are rapidly destroyed on the contact side
(D) Water molecules are actively drawn out of the contact side cells

80. The drooping of Mimosa pudica leaves is caused by:
(A) Turgor loss in pulvinus cells
(B) Sudden localized increase in cellular division
(C) Rapid synthesis and accumulation of auxin gas
(D) Mechanical structural breakage of the leaf stem

81. How long does it usually take for the leaves of Mimosa pudica to recover and open again after being touched?
(A) A few milliseconds
(B) A few seconds
(C) 15 to 30 minutes
(D) 24 hours

82. Which statement correctly differentiates tropic from nastic movements?
(A) Tropic movements are fast; nastic movements are slow.
(B) Tropic movements occur only in roots; nastic movements occur only in leaves.
(C) Tropic movements are directional; nastic movements are non-directional.
(D) Tropic movements are reversible; nastic movements are permanent.

83. The practical application of gibberellins in the agriculture industry is often associated with:
(A) Selectively killing unwanted broad-leaved weed species
(B) Accelerating the ripening rate of raw bananas in storage
(C) Artificially promoting premature leaf fall before harvest
(D) Increasing grape stalk length and fruit size

84. Which plant hormone acts as an antagonist (has the opposite effect) to gibberellins regarding seed germination?
(A) Auxin
(B) Abscisic acid
(C) Cytokinin
(D) Ethylene

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85. Arrange the following steps of stomatal opening in the correct order:
I. Water enters the guard cells.
II. Guard cells become turgid (swell).
III. The stomatal pore opens.
IV. Osmotic pressure increases inside guard cells.

(A) I, II, III, IV
(B) IV, I, II, III
(C) II, I, IV, III
(D) I, IV, II, III

86. What is the role of potassium ions in the mechanism of stomatal opening?
(A) They structurally degrade and destroy the surrounding guard cell walls
(B) They physically block the stomatal pore to

prevent transpiration water loss
(C) They enter guard cells, drawing water in osmotically
(D) They biochemically convert accumulated starch into active auxin molecules

87. Under which of the following conditions would abscisic acid most likely be synthesized in large amounts in a plant?
(A) During a heavy rainfall
(B) During spring when new leaves form
(C) When the plant is exposed to optimal sunlight
(D) Under severe drought stress

88. Fruit vendors often use a chemical compound called Ethephon to ripen fruits like mangoes and bananas. Ethephon releases which plant hormone?
(A) Ethylene
(B) Auxin
(C) Cytokinin
(D) Gibberellin

89. Which of the following is a characteristic feature of plant hormones?
(A) They are synthesized exclusively within specialized organs or glands
(B) They circulate continuously throughout a vascular bloodstream network
(C) They are effective in minute concentrations
(D) They act strictly and exclusively on the exact cells that produce them

90. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Plants lack a nervous system, yet they can coordinate their responses to the environment.
Reason (R): Plants utilize a network of chemical messengers called phytohormones for control and coordination.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

91. The synthesis of which hormone is highest in areas of rapid cell division, such as the root apices and developing shoot buds?
(A) Abscisic acid
(B) Cytokinin
(C) Ethylene
(D) Gibberellin

92. Which hormone is often referred to as the "stress hormone" of plants?
(A) Auxin
(B) Gibberellin
(C) Abscisic acid
(D) Cytokinin

93. A gardener wants to prevent his potatoes from sprouting while in storage. Which type of hormone treatment might theoretically achieve this?
(A) Repeated spraying with active Gibberellin solutions
(B) Soaking the tubers in concentrated Cytokinin fluid
(C) Direct surface application of synthetic Auxin hormones
(D) Application of Abscisic acid

94. What causes the main stem of a plant to grow straight upwards when illuminated equally from all sides?
(A) Uniform auxin distribution across the stem
(B) Complete accumulation of auxin strictly within the root tissues
(C) Total absence and lack of functional auxin throughout stem cells
(D) High production of gaseous ethylene centered in the shoot tip

95. Consider the following statements about Ethylene:
I. It is a gaseous hormone.
II. It promotes fruit ripening.
III. It inhibits leaf fall (abscission).
Which of the above statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

96. If you observe that a potted plant placed near a window is bending towards the window, which phenomenon are you observing?
(A) Positive geotropism
(B) Negative phototropism
(C) Positive phototropism
(D) Thigmotropism

97. Which part of the plant root is highly sensitive to gravity?

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51. The formation of an abscission layer at the base of a leaf stalk, leading to leaf fall, is heavily influenced by the accumulation of:
(A) Cytokinin
(B) Gibberellin
(C) Starch
(D) Abscisic acid

52. Which biological process is directly responsible for the softening, colour change, and sweetening of fruits?
(A) Transpiration
(B) Fruit ripening
(C) Seed germination
(D) Root elongation

53. The biochemical process of fruit ripening is primarily regulated by the release of:
(A) Auxin gas
(B) Carbon monoxide
(C) Ethylene gas
(D) Nitrogen gas

54. Animal coordination relies on a nervous system and muscles. Plant coordination relies entirely on:
(A) Specialized nerve networks and circulatory blood
(B) Contractile muscle tissues and chemical hormones
(C) Central brain structures and spinal cord tissues
(D) Plant hormones and cellular turgor pressure

55. Consider the following differences between plant and animal coordination:
I. Plants use electrical impulses travelling through nerves for slow growth.
II. Plants use chemical hormones for both growth and movement.
III. Animals have specialized muscle cells for movement, whereas plants rely on cellular water content changes.
Which of the above statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) III only

56. What is the primary function of the guard cells located in the leaf epidermis?
(A) To absorb water and minerals directly from soil
(B) To transport photosynthetic food to plant roots
(C) To regulate stomatal pore opening and closing
(D) To protect leaf epidermis from external herbivores

57. The stomatal pores open when the guard cells:
(A) Lose water and shrink
(B) Produce large amounts of abscisic acid
(C) Undergo cell division
(D) Take up water and swell

58. When water flows out of the guard cells, they become flaccid. What happens to the stomatal pore?
(A) It closes.
(B) It opens wider.
(C) It remains unchanged.
(D) It turns into a lenticel.

59. Many plants are sensitive to the duration of light and dark periods for flowering. This phenomenon is termed as:
(A) Phototropism
(B) Photosynthesis
(C) Photoperiodism
(D) Photolysis

60. Which of the following is an internal factor that directly regulates plant growth?
(A) Soil moisture and hydration
(B) Genetic factors and hormones
(C) Ambient atmospheric temperature
(D) Relative atmospheric humidity

61. During conditions of severe water scarcity, which hormone acts as a stress signal in plants?
(A) Gibberellin
(B) Cytokinin
(C) Auxin
(D) Abscisic acid

62. How does abscisic acid help a plant survive during a drought?
(A) By causing stomata to close to conserve water
(B) By forcing roots to grow faster
(C) By increasing the transpiration rate
(D) By opening stomata to absorb moisture from the air

63. Which hormone promotes the development of seedless fruits (parthenocarpy) when applied artificially to unpollinated flowers?
(A) Abscisic acid

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110. The concept that a chemical substance produced in the shoot tip controls bending towards light was early studied by:
(A) Charles Darwin
(B) Gregor Mendel
(C) Louis Pasteur
(D) Robert Hooke

111. Which plant hormone helps in the synthesis of RNA and proteins, thereby aiding in rapid cell division?
(A) Abscisic acid
(B) Cytokinin
(C) Ethylene
(D) Auxin

112. The senescence (aging) of plant leaves is delayed by the application of:
(A) Ethylene
(B) Abscisic acid
(C) Cytokinins
(D) Auxins

113. During a flood, the roots of a plant become waterlogged and lack oxygen. The plant responds by producing a hormone that can cause older leaves to drop. Which hormone is this?
(A) Auxin
(B) Cytokinin
(C) Gibberellin
(D) Ethylene

114. Which statement about phytohormones is completely incorrect?
(A) They are organic compounds.
(B) They function effectively at very high concentrations only.
(C) They are synthesized in specific parts of the plant and translocated to other parts.
(D) They regulate growth, development, and responses to the environment.

115. Match the external stimulus in List I with the corresponding plant response in List II.
List I: (External Stimulus)
P. Light on one side
Q. Touch on tendril
R. Gravity pull
S. Touch on Mimosa
List II: (Plant Response)
1. Thigmotropism
2. Positive phototropism
3. Seismonasty
4. Positive geotropism

(A) P-2, Q-1, R-4, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-4, Q-3, R-2, S-1
(D) P-2, Q-4, R-1, S-3

116. If a plant's roots are growing towards a nutrient-rich fertilizer placed in the soil, this is a form of:
(A) Hydrotropism
(B) Chemotropism
(C) Thigmotropism
(D) Phototropism

117. Which of the following best explains why roots grow downwards into the soil?
(A) To actively escape sunlight exposure, guided exclusively by negative phototropism
(B) Because they are continuously pushed downwards by the physical weight of the stem
(C) For anchorage and water access, guided by positive geotropism
(D) Because soil chemicals exert an active, direct physical pull on the roots

118. When fruit is shipped over long distances, it is often picked unripe. Upon arriving at its destination, which gas is introduced to ripen the fruit?
(A) Oxygen
(B) Carbon dioxide
(C) Nitrogen
(D) Ethylene

119. The process by which plants alter their growth and development in response to environmental conditions, using hormones, is termed:
(A) Coordination
(B) Photosynthesis
(C) Transpiration
(D) Respiration

120. Which of the following hormones is not a growth promoter?
(A) Auxin
(B) Abscisic acid
(C) Gibberellin
(D) Cytokinin

121. The opening of stomata is largely regulated by the accumulation of which ions inside the guard cells?
(A) Dissolved sodium ions
(B) Dissolved calcium ions
(C) Metallic iron ions
(D) Potassium ions

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122. Under which condition do the guard cells become flaccid, causing the stomata to close?
(A) High water content in the leaf
(B) Loss of water from the leaf
(C) High light intensity
(D) Low carbon dioxide concentration

123. The ability of a plant to sense and respond to varying day lengths (light duration) is called:
(A) Phototropism
(B) Photosynthesis
(C) Photoperiodism
(D) Photolysis

124. Photoperiodism in plants primarily influences which critical developmental process?
(A) Root elongation
(B) Wood formation
(C) Leaf fall
(D) Flowering

125. Select the correct sequence of events showing a plant's response to an external stimulus:
(A) Stimulus perception → Hormone production → Hormone transport → Cellular response (Growth/Movement)
(B) Hormone transport → Stimulus perception → Cellular response → Hormone production
(C) Cellular response → Hormone production → Stimulus perception → Hormone transport
(D) Hormone production → Cellular response → Hormone transport → Stimulus perception

126. A farmer wants to promote lateral branch growth to make his tea plants bushier. Which practice will achieve this by removing the main source of auxin?
(A) Watering the plant excessively
(B) Pruning the shoot tips
(C) Applying fertilizer to the roots
(D) Keeping the plant in the dark

127. Removing the apical bud of a plant stops apical dominance. This allows the lateral buds to grow, which are stimulated by:
(A) Ethylene
(B) Abscisic acid
(C) Cytokinins
(D) Ascorbic acid

128. In agricultural practice, spraying which hormone can increase the yield of sugarcane by lengthening the stem internodes?
(A) Auxin
(B) Ethylene
(C) Abscisic acid
(D) Gibberellin

129. The most common natural auxin found in plants is:
(A) Indole-3-acetic acid (IAA)
(B) Naphthalene acetic acid (NAA)
(C) 2,4-Dichlorophenoxyacetic acid (2,4-D)
(D) Zeatin

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130. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The shoot of a plant bends towards light.
Reason (R): Auxin accumulates on the illuminated side of the shoot, inhibiting its growth.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

131. Which of the following is considered an external factor affecting plant growth?
(A) Genetic makeup
(B) Light availability
(C) Internal hormone concentration
(D) Age of the plant

132. How does temperature influence plant growth?
(A) Unusually high temperatures invariably increase overall growth rates continuously without limit
(B) Substantially low environmental temperatures dramatically speed up cellular respiration processes
(C) An optimum range exists for enzymes and hormones to function
(D) Atmospheric temperature variations have absolutely no effect on internal plant hormone activity

133. Which of the following statements about plant and animal coordination is true?
(A) Plant coordination responses are generally much faster than animal responses
(B) Animals rely exclusively on hormones, whereas plants rely solely on nerves
(C) Both plants and animals possess a centralized control organ such as a brain
(D) Plant responses are slower, driven by growth

or turgor

134. If you artificially apply high levels of cytokinin to a detached leaf, what will be the likely result?
(A) It will turn yellow and senesce very quickly
(B) It will remain green longer
(C) It will sprout adventitious roots immediately
(D) It will shrivel up and dehydrate instantly

135. Consider the following statements about the hormone Auxin:
I. It is synthesized at the root and shoot tips.
II. It promotes apical dominance.
III. It promotes the ripening of fruits.
Which of the above statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

136. Apical dominance is a phenomenon where the growth of lateral buds is inhibited by the active growth of the:
(A) Primary roots
(B) Mature leaves
(C) Apical bud
(D) Open flowers

137. Which of the following is a commercial application of auxins in horticulture?
(A) Significantly delaying commercial fruit ripening
(B) Rapidly closing leaf stomata to save cellular water
(C) Artificially breaking prolonged seed dormancy states
(D) Inducing roots on stem cuttings

138. Which hormone regulates the closure of stomata during daytime to minimize water loss in desert plants?
(A) Abscisic acid
(B) Cytokinin
(C) Gibberellin
(D) Auxin

139. The directional movement of a plant part in response to a stimulus is governed by:
(A) Sudden muscle contractions
(B) Unequal growth on two sides of the plant part
(C) The rapid transport of water from roots to leaves
(D) Complete cessation of photosynthesis

140. Arrange the following events to explain phototropism in a shoot:
I. Light shines from one side.
II. Auxin diffuses to the shaded side.
III. Cells on the shaded side elongate faster.
IV. The shoot bends towards the light.
(A) I, III, II, IV
(B) I, II, III, IV
(C) II, I, III, IV
(D) III, IV, I, II

141. The inner wall of the guard cell surrounding the stomatal pore is:
(A) Thinner than the outer wall
(B) Absent
(C) Made of rigid bone-like tissue
(D) Thicker than the outer wall

142. What happens to the thick inner walls of the guard cells when they become turgid?
(A) They curve outward, opening the pore
(B) They collapse flat inwards, tightly closing the pore
(C) They dissolve temporarily due to enzymatic degradation
(D) They fuse together permanently along their inner margins

143. Which plant movement is entirely independent of plant growth?
(A) Phototropic growth
(B) Geotropic growth
(C) Nastic movement
(D) Chemotropic growth

144. Which hormone is generally considered the main inhibitor of plant growth?
(A) Auxin
(B) Gibberellin
(C) Cytokinin
(D) Abscisic acid

145. Consider the following statements about hydrotropism:
I. It is the movement of plant parts towards water.
II. Roots exhibit positive hydrotropism.
III. It can overpower geotropism if water is scarce.
IV. It is a type of nastic movement.
Which of the above statements is/are correct?
(A) I, II, and III
(B) I, II, and IV
(C) II, III, and IV

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169. Identify the odd one out based on the function of plant hormones.
(A) Auxin
(B) Gibberellin
(C) Cytokinin
(D) Abscisic acid

170. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Roots show negative phototropism.
Reason (R): Roots grow away from the source of light and towards gravity.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

171. In terms of coordination, what advantage do tropic movements give to a plant?
(A) They enable plants to rapidly move away from environmental hazards
(B) They orient plant parts toward light and water
(C) They allow carnivorous plants to trap flying insects efficiently
(D) They maintain a stable internal temperature in changing climates

172. The movement of sunflower heads tracking the sun across the sky is an example of a light-induced movement that differs from standard phototropism because it can be reversible daily. This phenomenon is closely related to:
(A) Geotropism
(B) Heliotropism
(C) Thigmotropism
(D) Chemotropism

173. What is the role of cell turgor in the nastic movement of the sensitive plant?
(A) It strictly determines the orientation and direction of movement
(B) High resting turgor pressure completely prevents movement
(C) Cell turgor directly replaces metabolic water requirements
(D) Turgor loss causes rapid leaf drooping

174. Which process relies heavily on the coordinated opening and closing of stomata?
(A) Gas exchange and transpiration
(B) Passive mineral uptake from soil
(C) Long-distance food transport in phloem
(D) Active cellular biosynthesis of auxin

175. Consider the following statements about Cytokinins:
I. They promote cell division.
II. They are present in high amounts in seeds and fruits.
III. They promote the senescence (aging) of leaves.
Which of the above statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

176. Which of the following is a direct consequence of a plant failing to produce ethylene?
(A) Stem tissues will become dwarf and extremely short
(B) Fruits will stay green and unripe
(C) Stomatal pores will stay continuously open
(D) Roots and shoots will lose all sensitivity to gravity

177. The 'Bakane' or 'foolish seedling' disease of rice, which led to the discovery of gibberellins, is caused by a:
(A) Virus
(B) Bacteria
(C) Fungus
(D) Nematode

178. What happens to a plant's coordination mechanism when it is completely deprived of water for a long time?
(A) ABA closes stomata to conserve water
(B) Auxin spikes, forcing the shoot system to seek light
(C) Ethylene drops drastically to halt all normal leaf fall
(D) Gibberellin increases rapidly to extend stem length

179. The communication within a plant using hormones is fundamentally different from animal nervous systems because:
(A) Plant hormones generate instant responses in milliseconds
(B) Plant hormones require conscious nervous system stimulation
(C) Hormones act slowly via cell-to-cell diffusion
(D) Plant hormones circulate rapidly through

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(A) Unusually heavy and continuous seasonal rainfall
(B) Sustained changes in global atmospheric pressure
(C) Shorter day length and temperature drops
(D) Sudden spike in soil nutrient concentrations

158. The directional growth movement in plants is generally termed a 'tropism'. What does the prefix (photo-, geo-, hydro-) indicate?
(A) The overall speed of the directional movement
(B) The specific type of chemical hormone responsible
(C) The specific anatomical plant part that moves
(D) The external stimulus type

159. Which type of plant movement involves growth?
(A) Thigmotropism
(B) Seismonasty
(C) Nyctinasty
(D) Thermonasty

160. Choose the incorrect statement regarding plant hormones.
(A) They are effective in low concentrations.
(B) They are solely responsible for photosynthesis.
(C) They act at sites distant from where they are produced.
(D) They regulate growth, differentiation, and development.

161. In agricultural practices, synthetic plant hormones are sometimes used to produce fruits without fertilization. What are these fruits called?
(A) Parthenocarpic fruits
(B) Transgenic fruits
(C) Hybrid fruits
(D) Cloned fruits

162. A classic example of a naturally parthenocarpic fruit is the:
(A) Apple
(B) Mango
(C) Banana
(D) Papaya

163. The primary reason farmers spray 2,4-D (a synthetic auxin) in wheat fields is to:
(A) Rapidly ripen wheat grains prior to harvest
(B) Dramatically increase overall stem height in wheat
(C) Significantly boost total grain protein concentration
(D) Eliminate broad-leaved weeds selectively

164. What is the physiological consequence of an overproduction of gibberellins in a plant?
(A) The whole plant will become severely dwarfed and stunted
(B) Excessive stem elongation will occur
(C) The plant will shed all its leaves and branches immediately
(D) Roots will decay rapidly due to extreme water absorption

165. Select the correct order of increasing biological complexity in plant coordination:
(A) Environmental stimulus → Hormone synthesis → Receptor activation → Growth response
(B) Environmental stimulus → Receptor activation → Hormone synthesis → Growth response
(C) Hormone synthesis → Growth response → Environmental stimulus → Receptor activation
(D) Receptor activation → Growth response → Hormone synthesis → Environmental stimulus

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166. A student places a potted plant in a box with a single small hole for light to enter. What is the expected observation after a week?
(A) The plant will die due to lack of air.
(B) The stem will bend away from the hole.
(C) The leaves will fold up tightly.
(D) The stem will bend towards the hole.

167. Which of the following defines the term "apical dominance"?
(A) Unregulated rapid development and expansion of lateral roots
(B) Inhibition of lateral buds by the apical bud
(C) Accelerated shedding of foliage located at the tree apex
(D) Physiological dominance of mature leaves over emerging buds

168. To make hedges bushy, gardeners routinely trim the top of the plants. This relies on removing the source of which hormone?
(A) Cytokinin
(B) Ethylene
(C) Auxin
(D) Abscisic acid

(D) I, III, and IV

146. A classic experiment involves growing seedlings on a slowly rotating platform called a clinostat. What is the purpose of this experiment?
(A) To significantly increase light energy absorption
(B) To precisely measure the rate of root water absorption
(C) To artificially induce early flowering in seedlings
(D) To cancel directional gravity effects

147. If a plant is rotated continuously on a clinostat, how will its roots grow?
(A) Horizontally, straight out
(B) Upwards
(C) Downwards
(D) In a perfect circle backwards

148. Which tissue in a vascular plant is primarily responsible for the transport of the hormone auxin downwards from the tip?
(A) Xylem
(B) Phloem
(C) Epidermis
(D) Root cortex

149. The protective response of plants to touch, which deters herbivores, is best seen in which plant?
(A) Mango tree
(B) Rose bush
(C) Mimosa pudica
(D) Banyan tree

150. A farmer notices that all his tomatoes are green and hard. He puts a ripe, yellow banana in the box with them. Two days later, the tomatoes are red and soft. What caused this?
(A) The ripe banana rapidly absorbed all cold air inside the sealed box
(B) The ripe banana transferred its yellow pigment directly through contact
(C) The ripe banana released massive quantities of abscisic acid gas
(D) The banana released ethylene gas

151. Which part of the embryo first responds to gravity during seed germination?
(A) The radicle (future root)
(B) The plumule (future shoot)
(C) The cotyledons (seed leaves)
(D) The seed coat

152. In roots, a high concentration of auxin:
(A) Promotes rapid cell elongation
(B) Causes the root to turn green
(C) Inhibits cell elongation
(D) Forces the root to grow upwards

153. Why does a root bend downwards when placed horizontally?
(A) Auxin accumulates on the upper side, inhibiting growth there, so the lower side grows faster.
(B) Gravity directly pulls the root tip down like a heavy weight.
(C) Sunlight destroys auxin on the lower side.
(D) Auxin accumulates on the lower side, inhibiting growth there, so the upper side grows faster.

154. Plant tissue culture relies heavily on the manipulation of hormones. The mass of undifferentiated cells formed during this process is called:
(A) A tendril
(B) A callus
(C) A pulvinus
(D) A stoma

155. Match the examples in List I with the correct terms in List II.
List I: (Examples)
P. Roots finding soil moisture
Q. Leaves wilting on a hot day due to stress
R. Pollen tube reaching ovule
S. Sunflowers tracking the sun
List II: (Terms)
1. Chemotropism
2. Phototropism
3. Hydrotropism
4. Action of Abscisic acid
(A) P-3, Q-4, R-1, S-2
(B) P-4, Q-3, R-2, S-1
(C) P-3, Q-1, R-4, S-2
(D) P-1, Q-2, R-3, S-4

156. Abscission of leaves and fruits occurs primarily due to the formation of a distinct layer of cells called the:
(A) Vascular cambium layer
(B) Abscission layer
(C) Outer epidermal layer
(D) Leaf mesophyll layer

157. Which environmental cue is primarily responsible for triggering leaf fall (abscission) in deciduous trees during autumn?

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specialized blood vessels

180. A plant is growing in a dark room with a single light source. If you cover the tip of the stem with an opaque cap, what will happen?
(A) The stem will bend towards the light.
(B) The stem will bend away from the light.
(C) The stem will grow straight up, unbent.
(D) The root will come out of the soil and grow towards the light.

181. Which part of the seedling is typically the most phototropic?
(A) Root apex
(B) Shoot apex
(C) Cotyledons
(D) Hypocotyl base

182. Identify the incorrect statement regarding the sensitive plant (Mimosa pudica).
(A) The movement is caused by a change in cell shape due to water loss.
(B) The folding of leaves is a growth-related movement.
(C) The stimulus is touch.
(D) It does not possess a nervous system.

183. Identify the correct pair.
(A) Phototropism - Response to chemicals
(B) Geotropism - Response to gravity
(C) Hydrotropism - Response to touch
(D) Thigmotropism - Response to light

184. Identify the incorrect pair regarding hormone function.
(A) Auxin - Promotion of apical dominance in shoot tips
(B) Ethylene - Natural gaseous fruit ripening agent
(C) Abscisic acid - Maintains seed dormancy
(D) Cytokinin - Delaying senescence in green leaves

185. Consider the following statements:
I. Nastic movements are non-directional.
II. Tropic movements are directional.
III. Tropic movements depend on growth.
IV. Nastic movements in Mimosa depend on growth.
Which of the above statements is/are correct?
(A) I, II, and III
(B) II, III, and IV
(C) I, III, and IV
(D) I, II, and IV

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186. Which feature is unique to plants for maintaining an upright posture despite lack of a skeletal system?
(A) Continuous fluctuations in hormonal balances alone
(B) Rapid microscopic muscular fiber contractions
(C) Turgor pressure and rigid cell walls
(D) Constant propagation of electrical nerve impulses

187. The term "phytoregulation" refers broadly to:
(A) The chemical control and prevention of plant diseases
(B) Hormonal control of plant growth
(C) The cellular process of plants absorbing carbon dioxide
(D) The mechanical pruning and shaping of crop plants

188. Which of the following is NOT an application of synthetic plant hormones?
(A) Inducing rooting on vegetative stem cuttings
(B) Selective eradication of agricultural weeds
(C) Significantly enhancing commercial fruit size
(D) Acting as a mineral fertilizer

189. A plant's growth response to a light stimulus is primarily mediated by the asymmetric distribution of:
(A) Cytokinin
(B) Auxin
(C) Ethylene
(D) Abscisic acid

190. Arrange the following parts of a plant in the order they typically respond to a gravity stimulus during germination:
I. Plumule grows upwards.
II. Radicle emerges from the seed.
III. Radicle grows downwards.
IV. Lateral roots develop.
(A) II, III, I, IV
(B) I, II, III, IV
(C) III, II, I, IV
(D) II, I, IV, III

191. The bending of a shoot towards light is due to:
(A) Shrinkage of cells on the illuminated side
(B) Elongation of cells on the shaded side
(C) Rapid cell division on the illuminated side
(D) Death of cells on the shaded side

192. Which gas is responsible for the closing of stomata during drought conditions?

(A) Elevated concentration of carbon dioxide gas
(B) High concentration of atmospheric oxygen gas
(C) None; it is regulated by Abscisic acid
(D) Gaseous ethylene produced during drought

193. In a flower, what ensures that the pollen tube grows exactly towards the ovary?
(A) Positive phototropism
(B) Positive chemotropism
(C) Negative geotropism
(D) Positive hydrotropism

194. Which of the following is the most appropriate description of plant coordination?
(A) Rapid, conscious, and nerve-driven responses
(B) Slow, chemical, and growth-oriented
(C) Instantaneous, physical, and non-directional
(D) Highly complex, muscle-driven, and reversible

195. Match the plant responses in List I with the corresponding hormones in List II.
List I: (Plant Responses)
P. Cell division promotion
Q. Seed dormancy induction
R. Stem elongation
S. Cell elongation (phototropism)
List II: (Hormones)
1. Gibberellin
2. Cytokinin
3. Auxin
4. Abscisic acid
(A) P-2, Q-4, R-1, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-4, Q-3, R-2, S-1
(D) P-2, Q-1, R-4, S-3

196. The process of coordination in plants is fundamentally meant to:
(A) Help the plant communicate with other plants
(B) Adjust to environmental changes and survive
(C) Increase the rate of water loss
(D) Stop the process of photosynthesis completely

197. Which of the following actions is not controlled by plant hormones?
(A) The developmental opening of a flower bud
(B) The abscission and falling of ripe fruits
(C) Transpirational pull of water in xylem
(D) Directional bending of stems towards light

198. A student observes that a climber plant is coiling around a wire fence. The student concludes this is an example of:
(A) Chemotropism
(B) Thigmotropism
(C) Seismonasty
(D) Hydrotropism

199. What would be the most likely result if a plant was genetically unable to produce Abscisic acid?
(A) It would continue to grow indefinitely without resting
(B) It would wilt and die rapidly in droughts
(C) It would consistently produce massive overgrown fruits
(D) Its root system would grow directly upwards out of soil

200. The concept that specific substances control plant growth was established long before the actual chemicals were identified. Today, these chemical regulators are collectively known as:
(A) Plant steroids
(B) Phytohormones
(C) Plant enzymes
(D) Plant vitamins

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ANSWERS

1. (A) Through chemical messengers called hormones
Coordination in plants relies on chemical control rather than a nervous system. Special chemical compounds known as plant hormones or phytohormones are synthesized in minute amounts by specific plant tissues. These chemical messengers diffuse throughout the organism to regulate physiological processes, including growth, development, environmental responses, and cellular differentiation across various plant organs.

2. (C) By changing growth patterns using hormones
Plants lack specialized sensory organs, nerve cells, and muscular networks found in animals. Instead, plants perceive environmental stimuli through cellular receptors and respond by altering their growth patterns. Phytohormones mediate these responses by regulating cell division, elongation, and tissue differentiation, causing directional growth movements or localized physiological adjustments to adapt effectively.

3. (A) Phytohormones
Phytohormones are naturally occurring organic substances produced in extremely low concentrations within plants. They function as chemical signals regulating almost every aspect of growth, development, and physiological activity. These regulators govern processes such as cell division, stem elongation, seed germination, flowering, fruit ripening, and responses to environmental stress factors.

4. (D) Thyroxine
Plant growth and development are governed by specific classes of hormones, including auxins, gibberellins, cytokinins, abscisic acid, and ethylene. In contrast, thyroxine is an endocrine hormone produced by the thyroid gland in vertebrate animals to regulate metabolic rates. Consequently, thyroxine plays no physiological role within plant structures or processes.

5. (B) At the shoot tip
Auxin is primarily synthesized in actively growing meristematic regions, particularly at the apical meristem of shoot tips. From the apex, auxin moves downward through parenchyma cells and vascular tissues toward lower stem parts. This polar transport establishes concentration gradients crucial for governing apical dominance, tropisms, and longitudinal cell elongation.

6. (C) Auxin
Auxin is the main plant hormone responsible for promoting cell elongation in young stems and shoots. It activates membrane-bound proton pumps, lowering the pH within cell walls. This acidification loosens cell wall microfibrils, allowing turgor pressure to expand cells longitudinally, which ultimately drives stem elongation and directional growth responses.

7. (D) It diffuses towards the shady side of the shoot.
Light exposure triggers the redistribution of auxin at the shoot apex. When light falls on one side of a plant shoot, auxin molecules migrate laterally away from the illuminated side toward the shaded side. This asymmetric distribution creates a higher concentration of auxin in the cells located on the shaded region.

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8. (A) The plant bends towards the light.
Higher auxin concentrations on the shaded side of a shoot stimulate faster cell elongation compared to the illuminated side. Because cells on the dark side grow longer while illuminated cells grow more slowly, the physical stem curves directionally toward the light source, a phenomenon known as positive phototropism in growing shoots.

9. (B) Helping in the growth of the stem
Gibberellins are vital plant growth promoters that induce stem elongation by stimulating both cell division and cell elongation in internodes. They promote dwarf plant extension, overcome genetic dwarfism, and facilitate seed germination by mobilizing stored reserves. Their physiological primary effect is enhancing overall shoot height and longitudinal stem development.

10. (C) Assertion (A) is true but Reason (R) is false.
Gibberellins are routinely applied in agriculture to break seed dormancy and stimulate germination

by inducing hydrolytic enzymes like amylase. However, gibberellins function as growth promoters rather than growth inhibitors. Seed dormancy maintenance is primarily controlled by abscisic acid, which counteracts gibberellin action to keep seeds in an inactive resting state.

11. (A) Cytokinin
Cytokinins are plant hormones specifically identified for their capacity to induce cytokinesis and promote rapid cell division. They function in conjunction with auxins to regulate cell cycle progression and morphogenesis. Higher cytokinin levels relative to auxins favor shoot differentiation, maintaining active cell proliferation in growing apical and lateral meristems.

12. (C) Fruits and seeds
Cytokinins are heavily concentrated in regions undergoing rapid cell division and expansion. Developing fruits and seeds contain the highest natural concentrations of cytokinins because these reproductive structures require active cellular proliferation. Additionally, root apices synthesize significant amounts of cytokinins, which are transported upward to promote growth across aerial plant parts.

13. (D) Cytokinin
Cytokinins play a central role in delaying leaf senescence, a process known as the Richmond-Lang effect. They preserve chlorophyll content, maintain protein synthesis, and mobilize nutrients toward tissues where cytokinins are present. By delaying structural degradation in leaves, cytokinins ensure prolonged photosynthetic functionality and preserve green foliage vitality.

14. (C) Growth inhibitor
Abscisic acid is classified as a primary plant growth inhibitor because it suppresses metabolic activity, slows cell elongation, and inhibits seed germination. It acts antagonistically against growth-promoting hormones like gibberellins and auxins. By slowing physiological processes, abscisic acid conserves energy and resources under unfavorable environmental conditions.

15. (C) I and III only
Abscisic acid acts as a plant growth inhibitor that induces leaf senescence, wilting, and abscission. It functions as a crucial stress hormone during drought, triggering rapid stomatal closure to minimize transpirational water loss. However, it does not promote stem elongation, which is instead stimulated by gibberellins and auxins.

16. (C) Abscisic acid
Abscisic acid promotes leaf and fruit fall by stimulating the development of a specialized separation layer called the abscission zone at the base of petioles and pedicels. Cell walls within this zone dissolve, weakening physical attachment. As a result, older leaves and mature fruits detach easily from the plant body.

17. (A) Ethylene
Ethylene is unique among plant hormones because it exists as a hydrocarbon gas under ambient conditions. Synthesized in aging leaves, senescent flowers, and ripening fruits, ethylene diffuses easily through intercellular air spaces and stem tissues. It acts as a gaseous signaling molecule to regulate ripening, abscission, and stress responses.

18. (C) Promoting fruit ripening
Ethylene is primarily known for accelerating fruit ripening in climacteric fruits. It triggers key biochemical changes, including starches turning into sugars, enzymatic breakdown of cell walls leading to fruit softening, degradation of green chlorophyll pigments, and synthesis of aromatic flavor compounds that characterize fully ripe, mature fruits.

19. (D) Tropic movement
A tropic movement is a growth movement of a plant part where the direction of response is determined by the direction of an external stimulus. These movements are slow, permanent, and growth-dependent. Examples include shoots bending toward light or roots growing toward gravity, demonstrating directional orientation toward environmental factors.

20. (A) Positive tropism
Directional tropisms are classified based on the orientation of growth relative to the stimulus. When a plant organ grows directly toward the origin of an external stimulus, the response is termed positive tropism. Conversely, growth away from the stimulus direction represents negative tropism, enabling targeted orientation toward beneficial cues.

21. (C) Light
Phototropism is the directional growth response of plant organs to light stimuli. Plant shoots

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generally exhibit positive phototropism by growing toward light sources to optimize light interception for photosynthesis. Photoreceptors called phototropins detect light direction, triggering asymmetric auxin distribution that drives differential stem elongation toward illumination.

22. (D) Shoots are positively phototropic; roots are negatively phototropic.
Plant shoots and roots show opposing responses to light. Shoots display positive phototropism by bending toward light sources to enhance photosynthetic efficiency. In contrast, roots usually show negative phototropism by growing away from light, ensuring they remain buried deep within the soil matrix to secure anchorage, nutrients, and moisture.

23. (A) Positive geotropism
Geotropism, also termed gravitropism, is the growth response of plants to gravity. Roots display positive geotropism because they consistently grow downward in the direction of gravitational force. Specialized dense amyloplasts in root cap cells sediment downward, orienting auxin distribution to direct growth toward soil moisture and anchorage.

24. (B) Shoot system
The shoot system of a plant exhibits negative geotropism because stems and leaves grow upward, directly away from the pull of gravity. This orientation elevates photosynthesizing tissues into sunlight and open air. Gravity perception in stem endodermal cells guides asymmetric auxin distribution, ensuring upward shoot growth regardless of seed orientation.

25. (C) I, II, and IV
Tropic movements are directional responses to specific stimuli: phototropism responds to light, geotropism responds to gravity, and chemotropism responds to chemical gradients. However, movement in response to touch is termed thigmotropism, whereas hydrotropism specifically refers to growth movements directed by moisture gradients or water availability in soil.

26. (C) Water
Hydrotropism is the directional growth movement of plant parts, especially roots, in response to moisture gradients. Roots sense uneven water distribution in soil and curve toward regions with higher moisture content. This positive hydrotropic response helps plants survive dry conditions by securing adequate water required for physiological metabolic survival.

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27. (D) Hydrotropism
When soil moisture is distributed unevenly, roots reorient their growth toward regions containing higher water concentrations. This directional growth response toward moisture is termed hydrotropism. The root tip detects local water gradients, altering auxin balance and cell elongation rates to curve the root toward accessible soil water sources.

28. (A) Chemotropism
The directional growth of a pollen tube through pistil tissues toward the ovule during fertilization is guided by chemical gradients. Synergid cells within the embryo sac secrete specific chemical signals, including calcium and proteins, attracting the germinating pollen tube. This growth in response to chemical stimuli exemplifies positive chemotropism.

29. (B) Chemical stimuli
Chemotropism is defined as the directional movement or growth response of plant organs in reaction to chemical stimuli. Plant tissues move toward higher concentrations of beneficial chemicals or away from toxic substances. Key examples include root growth toward nutrient concentrations and pollen tube extension toward ovule-secreted chemical cues.

30. (C) Thigmotropism
Thigmotropism is the directional growth response of plant parts to physical touch or mechanical contact with solid objects. Climbing plants and vines utilize specialized thread-like structures called tendrils that coil around solid supports upon contact. Differential growth rates across the tendril enable secure attachment and upright support.

31. (D) Touch or contact
Physical touch or mechanical contact serves as the specific external stimulus triggering thigmotropic responses in plants. When organs like tendrils make contact with a solid object, epidermal mechanosensory mechanisms detect the touch. This signal initiates asymmetric hormone distribution, leading to localized

differential growth rates around the supporting structure.

32. (A) The side away from the support grows faster.
When a tendril touches a support, auxin redistributes toward the side not in contact with the support. The higher auxin concentration on the non-contact side accelerates cell elongation there compared to the contact side. As a result, the non-contact side grows faster, causing the tendril to curve around the object.

33. (B) Nastic movements
Nastic movements are plant responses where the direction of movement is entirely independent of the direction of the external stimulus. Unlike tropic movements, nastic movements are non-directional, often rapid, and frequently driven by sudden reversible changes in cell turgor pressure rather than permanent directional cell growth responses.

34. (C) Sensitive plant leaves folding upon touch
The rapid folding of leaves in the sensitive plant upon touch is a classic nastic movement. The direction of leaf folding remains the same regardless of where touch is applied. This non-directional response is driven by rapid turgor pressure loss in pulvinus cells rather than directional plant growth.

35. (D) P-4, Q-3, R-2, S-1
Auxin promotes cell elongation on the shaded side during phototropism. Gibberellin stimulates stem and internode elongation. Cytokinin promotes active cell division across growing tissues. Abscisic acid functions as a growth inhibitor that closes stomata during stress conditions. Matching these specific physiological roles aligns correctly with each plant hormone.

36. (A) Chui-mui
Mimosa pudica is widely known by the vernacular name Chui-mui in Hindi, which translates to touch-me-not. This herbaceous plant is famous for its extreme touch sensitivity. When touched or shaken, its compound leaves fold inward and droop rapidly as an immediate defense mechanism against potential physical damage.

37. (C) Touch stimulus
Leaves of Mimosa pudica rapidly collapse and fold inward when triggered by mechanical touch, vibration, or physical impact. Specialized mechanical receptors detect touch stimuli, generating an electro-chemical signal that travels along the petiole. This signal prompts immediate water efflux from pulvinus cells, causing dramatic leaf drooping within seconds.

38. (D) Seismonasty
The touch-induced movement in Mimosa pudica is classified as seismonasty, a form of nastic response triggered by mechanical shocks, touch, or wind. Because the direction of leaf folding is predefined by pulvinus anatomy rather than stimulus direction, it represents non-directional movement governed by rapid turgor pressure changes.

39. (B) Rapid and independent of direction
Nastic movements in sensitive plants differ fundamentally from tropic growth movements. While tropisms are slow, permanent, and oriented relative to stimulus direction, nastic responses in Mimosa pudica are rapid, reversible, and completely independent of stimulus direction, occurring via osmotic water shifts in specialized leaf base tissue cells.

40. (B) Cellular water loss and turgor changes
The movement of leaves in Mimosa pudica relies on rapid changes in cellular turgor pressure. When triggered, potassium and chloride ions rush out of motor cells at the leaf base, causing water to leave the cells osmotically. This sudden loss of water pressure makes the cells flaccid, causing leaf drooping.

41. (D) Pulvinus
The pulvinus is a specialized swollen structure located at the base of the leaf stalk and leaflets in Mimosa pudica. Containing flexible thin-walled parenchymal cells, the pulvinus acts as an osmotic hinge. Rapid loss or gain of water within pulvinus cells alters internal turgor pressure, driving leaf movement.

42. (C) They are always permanent growth movements.
Nastic movements are non-directional plant responses independent of stimulus direction. Unlike tropic movements, nastic responses are generally rapid and reversible processes driven by temporary changes in cell turgor pressure rather than permanent cellular growth. The rapid folding and reopening of Mimosa leaves illustrates this non-growth-based, temporary movement mechanism.

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43. (D) To regulate growth, flowering, and fruiting
Synthetic plant growth regulators are widely used in commercial agriculture and horticulture to manage plant development. Applied in precise concentrations, these synthetic compounds regulate stem height, induce uniform flowering, prevent premature fruit drop, promote seedless fruit formation, and synchronize fruit ripening to enhance crop yields and marketability.

44. (A) Auxin
Synthetic auxins are widely applied in agriculture to stimulate uniform flowering, enhance fruit set, and prevent early fruit dropping in crop species. By regulating cell division and tissue expansion in floral structures, controlled auxin application ensures consistent flower production, improves crop yields, and supports synchronized commercial harvest schedules.

45. (B) Contact with support → Auxin diffuses to non-contact side → Non-contact side grows faster → Tendril coils around support
When a tendril touches a physical support, mechanical stimulation triggers the lateral migration of auxin away from the point of contact. Accumulating on the non-contact side, auxin stimulates faster cell elongation there. This differential growth causes the tendril to curve toward the contact side, coiling tightly around the support.

46. (C) Gibberellin
Seed dormancy prevents seed germination until environmental conditions are optimal. Gibberellins play a critical role in breaking seed dormancy by stimulating mRNA synthesis for hydrolytic enzymes such as alpha-amylase. These enzymes digest stored starch into soluble sugars, providing energy and nutrients required for embryonic growth and radicle emergence.

47. (D) Abscisic acid
Abscisic acid acts as an antagonist to gibberellins regarding seed germination. While gibberellins break dormancy and stimulate embryo growth, abscisic acid promotes and maintains seed dormancy. It prevents premature germination under unfavorable conditions by suppressing metabolic activity and inhibiting transcription of hydrolytic enzymes needed for embryo growth.

48. (A) Gibberellin and Cytokinin
Early seed germination requires metabolic activation, stored reserve breakdown, and rapid cellular proliferation. Gibberellin synthesizes hydrolytic enzymes to mobilize stored carbohydrates, while cytokinin promotes active cell division in embryonic tissues. Working together, these two growth-promoting hormones drive early root and shoot elongation during embryonic development.

49. (B) Abscission
Abscission is the physiological process by which plants shed mature fruits, flowers, and old leaves. Controlled by hormonal shifts, particularly decreasing auxins and increasing abscisic acid or ethylene, an abscission layer forms at the organ base. Cell wall structural breakdown within this layer leads to clean separation from stems.

50. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Ethylene gas is widely used in commercial agriculture to artificially trigger uniform fruit ripening in stored or harvested produce. Ethylene is a naturally occurring plant hormone that accelerates enzymatic breakdown of chlorophyll, increases sugar accumulation, softens fruit cell walls, and enhances respiration rates involved in ripening processes.

51. (D) Abscisic acid
Leaf fall in deciduous plants is promoted by the accumulation of abscisic acid at the leaf petiole base. Increased abscisic acid levels stimulate the synthesis of hydrolytic enzymes that digest cell wall components, forming a distinct abscission zone. This weakens mechanical support, leading to premature leaf separation.

52. (B) Fruit ripening
Fruit ripening is a complex biochemical process involving chlorophyll degradation, synthesis of pigments like carotenoids, conversion of starches into simple sugars, and enzymatic softening of cell walls. These physiological changes transform hard, acidic, green unpollinated or pollinated ovaries into soft, sweet, colorful, and edible mature fruits.

53. (C) Ethylene gas
Ethylene is a gaseous plant hormone that acts as the primary biochemical signal driving fruit ripening. As fruits mature, ethylene synthesis

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95. (A) I and II only
Ethylene is a gaseous plant hormone that promotes fruit ripening, leaf senescence, and organ abscission. Instead of inhibiting leaf fall, ethylene stimulates the formation of the abscission zone at leaf bases, facilitating leaf drop. Thus, ethylene functions as a key gaseous promoter of ripening and developmental senescence processes.

96. (C) Positive phototropism
A potted plant placed near a window receives light predominantly from one direction. Auxin migrates to the shaded side of the stem, stimulating faster cell elongation there compared to the lit side. This differential elongation curves the stem toward the window light source, demonstrating positive phototropism in growing shoots.

97. (D) Root cap
The root cap is the primary gravisensing structure in roots. Specialized cells called statocytes within the root cap contain dense, starch-filled organelles called statoliths that sediment toward gravity. This physical settling triggers asymmetric auxin distribution, guiding positive geotropism and directing root growth downward into soil for moisture.

98. (A) Touch
Tendrils are specialized thread-like stem or leaf modifications present in climbing plants. They exhibit touch sensitivity through mechanosensory mechanisms in epidermal cells. Upon contact with a solid support, tendrils undergo differential growth triggered by touch stimuli, coiling around the structure to anchor the plant and elevate stems into sunlight.

99. (B) Electro-chemical changes in cellular water content
When touched, Mimosa pudica leaves send electrical and chemical signals from sensory epidermal cells to the pulvinus. These signals trigger rapid ion flux out of motor cells, causing water to leave osmotically. Loss of cellular water content reduces turgor pressure, causing rapid, coordinated folding and drooping of leaflets.

100. (C) Turgor pressure
Rapid nastic movements in Mimosa pudica rely on changes in cellular turgor pressure within the pulvinus. Touch stimuli trigger ion loss from motor cells, prompting water to leave osmotically. Reduced turgor pressure collapses thin-walled pulvinar cells, causing leaf folding. Re-absorbing water restores turgor pressure and returns leaves to upright orientation.

101. (D) Folding of leaves in the sensitive plant
Tropic movements are directional growth responses oriented relative to stimulus direction, such as roots growing toward gravity, shoots bending toward sunlight, or pollen tubes growing toward ovary chemicals. Conversely, leaf folding in sensitive plants is a non-directional nastic movement driven by turgor loss, occurring independently of stimulus orientation.

102. (A) It decreases.
When abscisic acid signals guard cells during water stress, potassium ions and water flow out, rendering guard cells flaccid and closing the stomatal pore. Closed stomata halt the outward diffusion of water vapor from leaf mesophyll tissues, resulting in a sharp decrease in the overall rate of transpiration.

103. (B) Gibberellin
Gibberellins play a key role in breaking bud and seed dormancy during spring. Rising spring temperatures trigger gibberellin synthesis, which activates hydrolytic enzymes that digest stored nutrients. Mobilized food reserves nourish the embryo and lateral buds, stimulating cell division and elongation to initiate active bud break and seed germination.

104. (D) Gibberellin – Increasing fruit size
Gibberellins are widely used in agriculture to enlarge fruit size and elongate stalk pedicels, particularly in seedless grape production. In contrast, artificial fruit ripening is governed by ethylene gas, selective weed control is accomplished using synthetic auxins, and breaking seed dormancy is primarily promoted by gibberellins rather than ethylene.

105. (B) I, II, and IV
Plant coordination relies on chemical hormones, resulting in slower responses compared to fast animal nervous systems. Hormonal regulation helps plants adapt to environmental changes. However, not all plant coordination involves directional growth; non-directional nastic movements operate via rapid turgor pressure

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64. (D) Negative geotropism
When a plant stem is placed horizontally, auxin accumulates on the lower side due to gravity. Elevated auxin stimulates faster cell elongation on the lower side, causing the tip to curve upward. Because growth occurs away from gravitational pull, the upward bending of the stem demonstrates negative geotropism.

65. (B) I, II, and IV
Auxin promotes cell elongation in growing stems, cytokinin stimulates active cell division, and abscisic acid promotes seed dormancy during stress. However, gibberellin promotes stem extension and seed germination rather than leaf fall. Leaf fall is instead promoted by abscisic acid and ethylene through abscission layer formation.

66. (B) The direction of gravity
Germinating seeds sense gravitational force regardless of seed placement orientation. Specialized starch-filled organelles called statoliths inside root cap cells sediment in the direction of gravity. This gravisensing directs positive geotropism in roots to grow downward and negative geotropism in shoots to grow upward, securing soil resources and light.

67. (C) Through cellular receptors and chemical signaling pathways
Plants lack sense organs, nerve networks, or muscular tissues. They detect environmental cues like light, gravity, moisture, and temperature using specialized cellular receptors, including photoreceptors and mechanosensors. These receptors initiate intracellular chemical signaling cascades and hormonal redistributions that modulate cell division and expansion, enabling precise physiological responses.

68. (D) Wind
Tropic movements are directional growth responses governed by directional external stimuli such as light, gravity, chemical gradients, or water availability. While wind can mechanically stress stems, inducing non-directional structural changes known as thigmomorphogenesis, wind direction does not typically serve as a primary stimulus driving classic directional tropic growth.

69. (A) Auxins
Synthetic auxins, such as 2,4-dichlorophenoxyacetic acid, are widely utilized as selective weedicides in agricultural management. Broad-leaved dicotyledonous weeds absorb synthetic auxins rapidly, leading to unsustainable cell elongation, metabolic dysregulation, and tissue death, while monocotyledonous cereal crops remain largely unaffected by these hormone concentrations.

70. (B) Auxin and Cytokinin
Plant tissue culture relies on precise quantitative ratios of auxin and cytokinin to govern organogenesis in an undifferentiated callus. High auxin-to-cytokinin ratios stimulate root development, whereas high cytokinin-to-auxin ratios promote shoot formation. Balanced concentrations maintain cell division, allowing controlled plantlet regeneration from cultured plant tissues.

71. (B) The tip produces a hormone required for phototropism.
Decapitating a seedling shoot apex removes the site of auxin synthesis. Without apical auxin production, lateral diffusion across shaded tissues ceases, preventing differential cell elongation required for stem curvature. Reapplying auxin synthetically or replacing the tip restores phototropic sensitivity, confirming the tip synthesizes the hormone governing phototropism.

72. (D) Phloem and cell-to-cell diffusion
Auxin synthesized at shoot tips is transported downward toward lower stem elongation zones through specialized cell-to-cell polar transport and phloem parenchyma tissue. Transporter proteins on cell membranes direct unidirectional auxin movement, establishing precise concentration gradients needed to drive cell elongation, vascular development, and directional tropisms in shoots.

73. (B) Nastic movement
The closing or folding of flower petals after sunset is a non-directional movement known as nyctinasty, a category of nastic movement. Governed by environmental light and dark cycles, this response depends on localized differential growth or osmotic turgor pressure changes in petal cells rather than directional stimulus orientation.

74. (D) Nyctinasty
Nyctinasty refers to the non-directional sleep movements of plant organs, such as leaves and

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surges, triggering expression of genes encoding cell-wall hydrolyzing enzymes, chlorophyll-degrading enzymes, and starch-converting amylases, which collectively cause fruit softening, sweetening, color changes, and aroma production.

54. (D) Plant hormones and cellular turgor pressure
Unlike animals, plants lack nervous tissues and muscular systems. Plant coordination depends on phytohormones to direct long-term growth responses, cell elongation, and tissue development. For rapid non-growth movements, plants alter cellular turgor pressure by regulating water shifts, allowing mechanical folding or movement without requiring muscle fibers or nerves.

55. (B) II and III only
Plants lack electrical nervous networks for growth; instead, they rely on chemical hormones to coordinate growth and movement. Unlike animals that utilize specialized muscle proteins for contraction, plants accomplish movement by altering cell water content and turgor pressure. Therefore, chemical hormone signaling and turgor modulation drive plant responses.

56. (C) To regulate stomatal pore opening and closing
Guard cells are specialized kidney-shaped epidermal cells surrounding each stomatal pore on leaves. Their primary function is regulating the opening and closing of stomata to balance carbon dioxide uptake for photosynthesis with transpirational water loss. Turgor pressure changes within guard cells control the dimensions of the stomatal aperture.

57. (D) Take up water and swell
Stomata open when guard cells absorb water osmotically and become turgid. As water enters, internal hydrostatic pressure increases. Because the inner cell walls facing the pore are thicker and less elastic than outer walls, guard cells bow outward as they swell, pulling the pore open to permit gas exchange.

58. (A) It closes.
When water leaves guard cells, internal turgor pressure drops significantly, causing the cells to lose shape and become flaccid. As guard cells shrink, their elastic outer walls return to resting positions, bringing the thick inner walls together and closing the stomatal pore to prevent further transpirational water loss.

59. (C) Photoperiodism
Photoperiodism is the physiological response of organisms to relative lengths of day and night. Plants detect photoperiods using photoreceptor proteins like phytochrome. Day length dictates transition timing from vegetative growth to reproductive flowering, allowing short-day, long-day, or day-neutral plants to align flower production with seasonal environmental conditions.

60. (B) Genetic factors and hormones
Plant growth and physiological development are regulated by internal and external factors. Internal factors include genetic inheritance, which defines growth potential, and phytohormone balances that signal cellular processes. External environmental factors such as sunlight, temperature, soil water, and ambient humidity influence these internal genetic and hormonal mechanisms.

61. (D) Abscisic acid
Abscisic acid functions as the principal plant stress hormone during severe water deficits. When soil water levels decline, roots synthesize abscisic acid and transport it through xylem tissues to leaves. Abscisic acid triggers rapid ion efflux from guard cells, causing turgor loss and stomatal closure to conserve water.

62. (A) By causing stomata to close to conserve water
During drought conditions, abscisic acid levels rise rapidly in leaf tissues. Abscisic acid binds to receptors on guard cell membranes, triggering an outflow of potassium ions and water loss. Flaccid guard cells cause stomatal closure, dramatically reducing transpirational water loss and helping the plant survive periods of moisture stress.

63. (C) Auxin
Exogenous application of auxins to unpollinated flower ovaries induces seedless fruit development without fertilization, a process termed parthenocarpy. Auxin stimulates ovary wall cell expansion and division, mimicking signals normally triggered by pollination. This technique is widely utilized in horticulture to produce commercially valuable seedless fruits like tomatoes.

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85. (B) IV, I, II, III
Stomatal opening begins when solute accumulation increases osmotic pressure inside guard cells. Water then enters guard cells osmotically from surrounding epidermal cells. The influx of water causes guard cells to swell and become turgid, bowing outward due to differential wall thickness, which ultimately opens the stomatal pore.

86. (C) They enter guard cells, drawing water in osmotically
Light triggers proton pumping out of guard cells, driving potassium ions inward through membrane channels. Accumulated potassium increases intracellular solute concentration, lowering water potential. Water enters guard cells from adjacent epidermal cells via osmosis, increasing turgor pressure and swelling guard cells outward to open the stomatal aperture.

87. (D) Under severe drought stress
Abscisic acid synthesis increases dramatically when plants experience severe water deficit or drought conditions. Dehydrated root tissues synthesize abscisic acid and transport it through xylem pathways to foliage. Elevated levels in leaves trigger guard cell ion loss, inducing stomatal closure to minimize transpirational water loss and prevent desiccation.

88. (A) Ethylene
Ethephon is an aqueous chemical agent commonly applied in commercial agriculture to accelerate fruit ripening. Upon absorption by plant tissues, ethephon decomposes to release ethylene gas directly into plant cells. This released ethylene triggers metabolic cascades that hasten starch conversion, cell wall softening, and color change in fruits.

89. (C) They are effective in minute concentrations
Plant hormones are organic signaling molecules characteristically effective in extremely minute concentrations. Unlike animal hormones produced in discrete glands, phytohormones are synthesized in various tissues, including root tips, shoot apices, and young leaves. They diffuse through vascular tissues to alter cellular growth, differentiation, and development across distant target sites.

90. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Plants lack a nervous system, sensory organs, and muscular tissues, yet they effectively coordinate physiological responses to environmental stimuli. This coordination is governed by phytohormones, which act as chemical messengers. These chemical regulators migrate through tissues to alter cell division, expansion, and metabolic activity, coordinating plant development.

91. (B) Cytokinin
Cytokinins are synthesized in high concentrations within active meristematic zones undergoing rapid cell division, such as root apices, shoot tips, and expanding seed embryos. These growth regulators drive cytokinesis and nucleic acid synthesis, ensuring continuous cell proliferation necessary for organ differentiation and growth across developing root and shoot systems.

92. (C) Abscisic acid
Abscisic acid is widely designated as the stress hormone of plants because its synthesis increases significantly during environmental stress, including drought, salinity, and cold. Abscisic acid initiates physiological protective mechanisms, such as rapid stomatal closure, seed dormancy maintenance, and growth inhibition, conserving vital resources under harsh environmental conditions.

93. (D) Application of Abscisic acid
Potato sprout formation represents bud emergence breaking dormancy. Abscisic acid acts as a natural growth inhibitor that maintains bud dormancy and suppresses metabolic sprouting activity in tubers. Applying abscisic acid or synthetic dormancy-inducing agents suppresses lateral bud outgrowth, preserving potato tuber quality and preventing spoilage during prolonged commercial storage.

94. (A) Uniform auxin distribution across the stem
When a plant shoot receives equal illumination from all directions, light does not create lateral light gradients. As a result, auxin remains uniformly distributed across all sides of the shoot tip. Equal auxin concentration causes cells on all sides to elongate evenly, driving straight, vertical upward stem growth.

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petals, in response to daily light and dark cycles. Driven by circadian rhythms and reversible turgor changes in pulvinar or petiole tissues, nyctinasty allows plants to open foliage during daylight and close petals at night.

75. (A) P-4, Q-3, R-2, S-1
Phototropism is the directional growth response driven by light exposure. Geotropism represents growth directed by gravitational forces. Hydrotropism describes root movement toward moisture sources in soil. Chemotropism is guided by chemical signal gradients. Matching each specific tropic movement to its corresponding environmental stimulus validates these biological definitions.

76. (D) Hydrotropism can override geotropism in root growth.
While roots typically grow downward due to positive geotropism, localized water stress causes roots to bend laterally toward moist soil or wet clay pots. This experimental observation demonstrates that hydrotropic growth responses can override normal geotropic responses, prioritizing water acquisition necessary for physiological survival over gravity orientation.

77. (A) Ovule
During fertilization in flowering plants, the germinating pollen tube grows through style tissues guided by chemotropism. The ovule, specifically synergid cells within the embryo sac, secretes chemical signaling molecules, including chemotropic peptides and calcium gradients. These chemical signals attract the pollen tube directly toward the micropyle for egg fertilization.

78. (C) Positive thigmotropism
Tendrils of climbing pea plants exhibit positive thigmotropism by orienting growth toward physical contact objects. Contact with a solid support triggers unequal auxin distribution, accelerating cell elongation on the outer non-touching side. Consequently, the tendril coils tightly around the support, providing structural elevation for aerial plant growth.

79. (B) Auxin accumulates on the non-contact side
Touch perception on the contact side of a tendril causes auxin to migrate laterally to the non-contact side. The resulting higher auxin concentration on the outer side stimulates increased cell elongation compared to the contact side. This asymmetrical growth rate causes the tendril to bend toward and wrap around support structures.

80. (A) Turgor loss in pulvinus cells
Mechanical touch triggers an action potential in Mimosa pudica, causing rapid efflux of potassium and chloride ions from parenchymal cells in the leaf pulvinus. Water leaves the cells osmotically, leading to immediate loss of turgor pressure. Flaccid pulvinus cells can no longer support leaf weight, resulting in drooping.

81. (C) 15 to 30 minutes
Following touch stimulation and subsequent leaf drooping in Mimosa pudica, motor cells in the pulvinus actively re-absorb lost potassium ions and water through metabolic transport. Re-establishing full cellular turgor pressure takes approximately 15 to 30 minutes, after which the petiole and leaflets return to their fully upright state.

82. (C) Tropic movements are directional; nastic movements are non-directional.
Tropic movements are growth-based plant responses where the orientation of movement is strictly determined by the direction of an environmental stimulus, such as light or gravity. In contrast, nastic movements are non-directional responses where the movement pattern depends on plant anatomy and turgor mechanisms rather than stimulus direction.

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83. (D) Increasing grape stalk length and fruit size
Gibberellins are widely applied in commercial viticulture to increase pedicel length and overall cluster size in seedless grapes. Extending stalk length prevents tight fruit packing, reduces fungal disease incidence, and improves air circulation, while simultaneously promoting individual berry expansion to enhance agricultural crop yield and commercial market quality.

84. (B) Abscisic acid
Abscisic acid functions as a direct physiological antagonist to gibberellins during seed germination. While gibberellins break seed dormancy by inducing hydrolytic enzymes for starch digestion and embryo expansion, abscisic acid suppresses enzyme synthesis, maintains embryo inactivity, and enforces seed dormancy until environmental conditions favor successful seedling survival.

changes independent of directional growth processes.

106. (A) Root
Roots generally exhibit positive geotropism, growing downward in the direction of gravitational pull. Sedimentation of statoliths inside root cap statocytes directs auxin accumulation along the lower root tip surface. Inhibiting cell elongation on the lower side allows the upper side to elongate faster, bending the root downward toward moisture.

107. (B) Etiolation
Seedlings germinating in complete darkness undergo etiolation, growing excessively tall, spindly, and pale due to uninhibited stem elongation driven by high apical auxin concentrations. Lacking light, chlorophyll development is halted, leaving foliage yellowish. Etiolation maximizes vertical reach, aiding seedlings in piercing dark soil layers to access sunlight.

108. (C) Hydrotropism
Hydrotropism is the directional growth response of plant parts toward water sources. Roots exhibit positive hydrotropism, bending toward soil regions with higher water availability. Root tip cells perceive moisture gradients and alter hormone distribution, driving asymmetric cell elongation that curves the root system toward essential soil water reserves.

109. (D) The shoot tip
The shoot tip contains photoreceptor proteins, primarily phototropins, that detect light direction. Upon sensing unilateral illumination, the shoot apex coordinates lateral auxin transport away from the lit side toward the shaded side. Thus, the shoot tip acts as the receptor sensing light direction to initiate phototropic stem bending.

110. (A) Charles Darwin
Charles Darwin, alongside his son Francis Darwin, conducted foundational experiments on phototropism using canary grass coleoptiles. They demonstrated that the shoot tip perceives light directional stimuli and transmits a influence downward to the growth zone. Later research identified this mobile chemical signal as the plant growth hormone auxin.

111. (B) Cytokinin
Cytokinins promote rapid cell division by accelerating nucleic acid synthesis, protein accumulation, and cell cycle progression from G2 phase to mitosis. High concentrations of cytokinins in meristematic tissues stimulate cellular RNA and protein formation, providing essential structural components required for sustained cell proliferation during plant growth and morphogenesis.

112. (C) Cytokinins
Exogenous application of cytokinins delays leaf senescence by maintaining chlorophyll integrity, suppressing protein degradation, and preserving chloroplast structures. Cytokinins create metabolic sinks that draw nutrients, amino acids, and inorganic ions toward treated tissues, prolonging photosynthetic activity and keeping foliage functional and green for extended periods.

113. (D) Ethylene
Waterlogged roots suffer oxygen deprivation, triggering a stress pathway where the precursor 1-aminocyclopropane-1-carboxylic acid is synthesized in roots and transported upward to leaves. Converted into ethylene gas, it promotes cellulase activity in leaf petioles, causing abscission layer formation and dropping older leaves to reduce transpirational water demand.

114. (B) They function effectively at very high concentrations only.
Phytohormones are organic signaling compounds that function effectively in minute concentrations within plant tissues. High hormone concentrations often produce inhibitory or toxic effects rather than promoting growth. Synthesized in specific plant parts, hormones migrate through vascular or parenchymal tissues to regulate growth, differentiation, and stress responses at target sites.

115. (A) P-2, Q-1, R-4, S-3
Unilateral light induces positive phototropism, bending stems toward light. Touch on tendrils triggers positive thigmotropism for climbing support. Gravity pull directs root downward growth through positive geotropism. Touch on Mimosa leaves induces rapid seismonastic folding via turgor loss. Matching these stimuli and responses correctly aligns with plant physiology.

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137. (D) Inducing roots on stem cuttings
Auxins are extensively applied in horticulture as rooting powders to induce adventitious root initiation on vegetative stem cuttings. Applying synthetic auxins, such as indole-butyric acid, to the cut stem base accelerates root development, ensuring successful vegetative propagation and uniform clonal establishment of desired plant varieties.

138. (A) Abscisic acid
Desert plants utilize abscisic acid to minimize transpirational water loss during dry conditions. Abscisic acid binds to guard cell membrane receptors, triggering an influx of calcium ions that opens anion channels. Resulting solute loss causes guard cells to lose turgor, rapidly closing stomata during high evaporative demand.

139. (B) Unequal growth on two sides of the plant part
Directional tropisms in plants result from differential cell elongation on opposing sides of an organ. Hormonal signals, such as asymmetric auxin redistribution, cause cells on one side to elongate faster than those on the opposite side. This differential growth bends the stem or root toward or away from stimuli.

140. (B) I, II, III, IV
Phototropism begins when unilateral light shines on a shoot tip. Light perception causes auxin to migrate laterally to the shaded side. Elevated auxin on the shaded side stimulates faster cell elongation compared to the lit side. This differential growth causes the shoot stem to curve toward the light source.

141. (D) Thicker than the outer wall
Guard cells surrounding stomatal pores feature structurally unequal cell wall thickness. The inner wall bordering the pore is significantly thicker and less elastic than the outer wall facing adjacent epidermal cells. This structural differential allows guard cells to bow outward when turgid, facilitating stomatal pore expansion for gas exchange.

142. (A) They curve outward, opening the pore
When guard cells absorb water and become turgid, internal hydrostatic pressure expands the thin outer walls outward. Because the inner cell walls facing the pore are thicker and less flexible, they are pulled outward alongside the expanding outer walls, curving the guard cells and opening the stomatal aperture.

143. (C) Nastic movement
Nastic movements are non-directional plant responses independent of directional cell growth. Unlike tropic movements, which rely on irreversible cell elongation and division, nastic responses operate through rapid, reversible changes in cell turgor pressure within specialized motor tissues, such as the pulvinus in sensitive plants.

144. (D) Abscisic acid
Abscisic acid is recognized as the principal growth-inhibiting plant hormone. It antagonizes growth promoters like gibberellins and auxins by suppressing cell division, halting stem elongation, enforcing seed and bud dormancy, and inducing stomatal closure under stress, thereby conserving energy and water during unfavorable conditions.

145. (A) I, II, and III
Hydrotropism is the directional growth response of plant organs toward moisture gradients, with roots exhibiting positive hydrotropism. When soil water is scarce, hydrotropic responses can override normal geotropic orientation to prioritize water uptake. However, hydrotropism is a directional tropic growth movement, not a non-directional nastic movement.

146. (D) To cancel directional gravity effects
A clinostat continuously rotates growing plants horizontally, exposing all sides of roots and shoots equally to gravitational pull over time. This uniform rotation cancels the directional vector of gravity, preventing statolith sedimentation and asymmetric auxin distribution, allowing researchers to study plant growth absent gravitational directional stimulus.

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147. (A) Horizontally, straight out
When a growing plant is rotated continuously on a clinostat, the direction of gravitational pull changes constantly relative to root cells. Equal gravity exposure prevents statolith settling and asymmetrical auxin distribution. Without a directional gravitational gradient, roots do not bend downward, continuing to grow horizontally straight out.

148. (B) Phloem
Auxin synthesized in shoot apical meristems moves downward through plant stems via cell-to-

lateral buds are released from dormancy and stimulated by cytokinins to grow into branches. This horticulture technique promotes bushier growth and increases leaf yield in crop plants.

127. (C) Cytokinins
Apical dominance is maintained by high auxin concentrations synthesized at shoot tips, which suppress lateral bud development. Removing the apical bud decreases auxin levels while enabling cytokinins to accumulate in axillary nodes. Cytokinins stimulate cell division in lateral buds, promoting lateral shoot growth and branch expansion.

128. (D) Gibberellin
Spraying sugarcane crops with gibberellins stimulates internode elongation by increasing cell division and cell expansion in stem tissues. Longer internodes significantly increase total stem biomass and storage capacity for sucrose, leading to substantial increases in overall commercial sugar yields per crop field.

129. (A) Indole-3-acetic acid (IAA)
Indole-3-acetic acid is the primary naturally occurring auxin found in vascular plants. Synthesized mainly in shoot apical meristems and young expanding leaves, indole-3-acetic acid regulates apical dominance, cell elongation, vascular tissue differentiation, and tropic growth responses to light and gravity throughout plant structure.

130. (C) Assertion (A) is true but Reason (R) is false.
Shoots exhibit positive phototropism, bending toward unilateral light. However, light causes auxin to migrate away from the illuminated side to accumulate on the shaded side, where it stimulates faster cell elongation. Because auxin accumulates on the shaded side rather than the illuminated side, the stated reason is false.

131. (B) Light availability
Light availability is a crucial external environmental factor influencing plant growth, photosynthesis, phototropism, and photoperiodism. In contrast, genetic makeup, internal hormone concentrations, and plant age are intrinsic internal factors that regulate growth potential, cellular differentiation, and physiological maturation within plant tissues independently of external cues.

132. (C) An optimum range exists for enzymes and hormones to function
Temperature directly influences plant growth by modulating metabolic reaction rates governed by cellular enzymes and growth regulators. Plant enzymes function efficiently within an optimal temperature range. Temperatures below this range slow enzymatic kinetics, whereas excessively high temperatures denature proteins and disrupt metabolic activity, suppressing plant growth.

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133. (D) Plant responses are slower, driven by growth or turgor
Plant coordination relies on hormonal diffusion and cell turgor changes, producing slower responses compared to electrical nerve impulses in animals. Lacking a central nervous system, brain, or muscle fibers, plants coordinate responses through cell division, longitudinal cell elongation, or reversible water shifts within targeted plant tissues.

134. (B) It will remain green longer
Applying cytokinins to detached leaves significantly delays senescence by preserving chlorophyll content, maintaining protein synthesis, and protecting cell membrane structures. Cytokinins prevent nutrient degradation and sustain photosynthetic functionality, allowing treated leaves to remain green and physiologically active far longer than untreated leaves under similar conditions.

135. (A) I and II only
Auxin is synthesized at shoot and root tips and promotes apical dominance by suppressing lateral bud outgrowth. However, fruit ripening is regulated primarily by the gaseous hormone ethylene rather than auxin. Auxins facilitate early fruit development and parthenocarpy, but do not promote ripening in mature fruits.

136. (C) Apical bud
Apical dominance is the physiological phenomenon where active growth of the apical shoot tip suppresses lateral bud outgrowth. Auxin synthesized in the apical bud diffuses downward through stem tissues, inhibiting axillary bud development. Removing the apical bud abolishes this inhibition, allowing lateral branches to expand.

116. (B) Chemotropism
When roots alter their growth direction toward soil zones enriched with nutrient minerals or fertilizers, they exhibit positive chemotropism. Root cells sense chemical concentration gradients, altering local cell division and elongation rates to direct growth toward nutrient-rich pockets, optimizing mineral absorption required for plant metabolic processes.

117. (C) For anchorage and water access, guided by positive geotropism
Roots grow downward into soil primarily guided by positive geotropism, sensing gravitational pull via statoliths in root cap cells. Downward root growth anchors the plant securely in the substrate while providing continuous access to water and mineral nutrients located in deeper soil layers, supporting shoot system survival.

118. (D) Ethylene
Ethylene gas is commercially introduced into ripening rooms to trigger uniform ripening in unripened fruits shipped long distances. Ethylene stimulates metabolic processes, accelerating starch breakdown into sugars, softening cell walls through pectinase activation, and degrading green chlorophyll, thereby transforming firm green fruit into ripe, marketable produce.

119. (A) Coordination
Coordination in plants is the process by which various cellular, physiological, and developmental activities are synchronized in response to environmental cues. Regulated primarily by phytohormones and turgor mechanisms, coordination enables plants to orient growth, optimize photosynthesis, secure moisture, and adapt to changing seasonal conditions without a nervous system.

120. (B) Abscisic acid
Plant hormones are grouped into growth promoters and growth inhibitors. Auxins, gibberellins, and cytokinins act as growth promoters by stimulating cell division, elongation, and shoot development. Abscisic acid functions as a primary growth inhibitor, promoting seed dormancy, stomatal closure, leaf abscission, and suppressing growth under stress conditions.

121. (D) Potassium ions
Stomatal opening is driven by the active accumulation of potassium ions inside guard cells. Light triggers proton pumps that export hydrogen ions, driving potassium influx through selective membrane channels. Increased intracellular potassium lowers osmotic potential, drawing water into guard cells, increasing turgor pressure, and opening the stomatal pore.

122. (B) Loss of water from the leaf
Guard cells become flaccid when water leaves them due to reduced cellular water potential or increased transpirational water loss. During water deficit, guard cells lose turgor pressure and shrink. Their elastic outer walls relax, bringing inner walls together and closing the stomatal pore to prevent further moisture loss.

123. (C) Photoperiodism
Photoperiodism is the physiological capacity of plants to measure relative durations of light and darkness across a twenty-four-hour cycle. Photoreceptors like phytochrome detect daylight length, signaling floral transition genes to induce flowering in alignment with seasonal conditions, distinguishing short-day, long-day, and day-neutral plant species.

124. (D) Flowering
Photoperiodism primarily controls the physiological transition from vegetative growth to reproductive flowering. By sensing relative lengths of day and night, plants synchronize flower production with favorable seasonal environments, ensuring pollinator availability and optimal weather conditions for seed development, fertilization, and subsequent reproductive success across plant populations.

125. (A) Stimulus perception → Hormone production → Hormone transport → Cellular response (Growth/Movement)
Plant environmental response follows a sequential pathway: localized receptors detect external stimuli, triggering hormone synthesis or redistribution. These chemical messengers are transported through plant tissues to target cells, where they modify cell wall elasticity, gene expression, or turgor pressure, ultimately driving directional growth or physiological movement responses.

126. (B) Pruning the shoot tips
Pruning shoot tips removes the primary source of apical auxin synthesis, disrupting apical dominance. With reduced apical auxin levels,

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cell polar transport and phloem vascular tissue. Specialized efflux carrier proteins localized on basal cell membranes transport auxin downward through phloem parenchyma, distributing the hormone to sub-apical regions to regulate elongation and vascular development.

149. (C) Mimosa pudica
Mimosa pudica displays rapid touch-induced leaf folding, a seismonastic response serving as a protective mechanism. Mechanical stimulation by herbivores triggers action potentials that cause rapid turgor loss in pulvinus cells. The sudden collapsing leaves deter potential herbivores by appearing unpalatable and exposing sharp stem spines.

150. (D) The banana released ethylene gas
Ripe bananas produce and release significant quantities of gaseous ethylene hormone into the surrounding atmosphere. When enclosed in a container, released ethylene gas diffuses into unripened green tomatoes, triggering enzymatic cascades that convert starch into sugars, degrade chlorophyll, and soften cell walls, rapidly ripening the tomatoes.

151. (A) The radicle (future root)
During seed germination, the radicle emerges first and displays positive geotropism. Specialized statocyte cells in the root cap contain statoliths that settle in response to gravity, establishing an auxin gradient. This allows the emerging radicle to grow downward into soil to secure moisture, nutrients, and physical anchorage.

152. (C) Inhibits cell elongation
Unlike shoot tissues where elevated auxin concentrations promote elongation, root cells are highly sensitive to auxin. High auxin concentrations in root tissue inhibit cell elongation on that side. Consequently, differential auxin distribution in roots produces opposite curvature responses compared to shoots during tropisms.

153. (D) Auxin accumulates on the lower side, inhibiting growth there, so the upper side grows faster.
When a root is oriented horizontally, gravity causes statoliths to settle, directing auxin accumulation along the lower side. Because root cells are sensitive to auxin, high auxin concentrations suppress cell elongation on the lower side. The upper side elongates faster, bending the root tip downward into the soil.

154. (B) A callus
In plant tissue culture, explants cultured on nutrient media containing balanced concentrations of auxin and cytokinin undergo rapid cell division, forming an unorganized mass of undifferentiated parenchyma cells called a callus. Adjusting hormone ratios within the growth medium subsequently induces organogenesis, regenerating roots and shoots from the callus.

155. (A) P-3, Q-4, R-1, S-2
Roots directing growth toward moisture illustrate positive hydrotropism. Leaves wilting during drought stress reflect abscisic acid action initiating stomatal closure. Pollen tube extension toward ovary chemicals demonstrates chemotropism. Sunflowers tracking daily sun position exhibit phototropism. Matching these biological examples with physiological terms confirms correct functional relationships.

156. (B) Abscission layer
Abscission of leaves and fruits occurs through the formation of a distinct abscission layer at petiole or pedicel bases. Composed of thin-walled parenchymal cells, this layer synthesizes wall-degrading enzymes like pectinase under hormonal regulation, dissolving middle lamellae and allowing clean detachment of leaves or fruits.

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157. (C) Shorter day length and temperature drops
Autumn leaf fall in deciduous trees is primarily triggered by decreasing day length and lower ambient temperatures. Photoreceptors detect shorter light durations, altering hormonal balances by decreasing auxin production and increasing ethylene and abscisic acid levels, which initiates abscission layer formation and leaf shedding before winter.

158. (D) The external stimulus type
The prefix attached to the word tropism designates the specific type of external environmental stimulus directing plant growth. For instance, photo- signifies light stimuli in phototropism, geo- indicates gravity in geotropism, hydro- refers to water in hydrotropism, and chemo- denotes chemical gradients driving chemotropic growth responses.

159. (A) Thigmotropism
Thigmotropism is a directional growth movement where tendrils or stems alter growth rates upon contacting solid objects, resulting in permanent cell elongation around supports. Conversely, seismonasty, nyctinasty, and thermonasty are non-directional nastic responses driven by reversible cellular turgor shifts rather than growth-based structural cellular elongation.

160. (B) They are solely responsible for photosynthesis.
Plant hormones do not directly perform photosynthesis, which is driven by light energy absorbed by chlorophyll pigments within chloroplasts. Instead, phytohormones act as signaling molecules in minute quantities, regulating growth, tissue differentiation, cell division, stress responses, and physiological coordination across distant parts of the plant body.

161. (A) Parthenocarpic fruits
Seedless fruits developed without fertilization of ovules are termed parthenocarpic fruits. Exogenous application of synthetic plant hormones like auxins or gibberellins to unpollinated flower ovaries stimulates fruit wall growth and expansion, producing seedless, edible fruits like parthenocarpic tomatoes, grapes, and cucumbers for commercial agricultural production.

162. (C) Banana
Commercial edible bananas represent a classic natural example of parthenocarpy. Cultivated banana varieties are triploid and seed-sterile, producing fruits without needing ovule fertilization. Natural hormone production within ovary tissues drives fruit expansion, yielding seedless pulp consumed globally without requiring synthetic hormone treatments or artificial pollination.

163. (D) Eliminate broad-leaved weeds selectively
Farmers spray 2,4-dichlorophenoxyacetic acid, a synthetic auxin, in wheat fields as a selective herbicide. Broad-leaved dicotyledonous weeds absorb the chemical rapidly, triggering unsustainable, uncontrolled cell expansion and metabolic exhaustion that destroys the weeds, while monocotyledonous wheat plants remain unaffected due to differing vascular structure and metabolism.

164. (B) Excessive stem elongation will occur
Overproduction or excessive application of gibberellins causes hyper-elongation of stem internodes. Gibberellins stimulate both cell division and longitudinal cell expansion in sub-apical meristems. High levels cause plants to grow abnormally tall, spindly, and weak, a condition historically identified as foolish seedling disease in infected rice crops.

165. (B) Environmental stimulus → Receptor activation → Hormone synthesis → Growth response
Plant growth coordination follows a defined hierarchical sequence. An environmental stimulus, such as light or gravity, is initially detected by specific cellular receptors. Receptor activation triggers signaling pathways that stimulate localized hormone synthesis or transport, altering cell division or elongation to execute a directed physiological growth response.

166. (D) The stem will bend towards the hole.
Placing a potted plant inside a dark box with a single light entry hole provides unilateral light. Phototropins in the shoot tip perceive directional light, causing auxin migration to the shaded stem side. Enhanced cell elongation on the shaded side bends the stem toward the hole, exhibiting positive phototropism.

167. (B) Inhibition of lateral buds by the apical bud
Apical dominance is defined as the suppression of lateral or axillary bud growth by the active growing apical bud at the shoot tip. Auxin produced in the shoot apex moves downward, maintaining high systemic concentrations that inhibit lateral bud development, prioritizing upward main stem growth toward light.

168. (C) Auxin
Trimming shoot tips in hedges removes the primary source of apical auxin synthesis, effectively ending apical dominance. Reduced auxin concentration allows cytokinins to stimulate dormant lateral buds, promoting lateral branch development and expansion. This horticulture practice results in dense, bushy hedge growth preferred in ornamental garden landscaping.

169. (D) Abscisic acid
Auxin, gibberellin, and cytokinin are classified as plant growth promoters because they

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drive cell division, longitudinal elongation, tissue differentiation, and organ development. Conversely, abscisic acid acts as the main growth inhibitor, suppressing metabolic activity, enforcing seed dormancy, inducing stomatal closure, and promoting leaf abscission under stress conditions.

170. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Plant roots exhibit negative phototropism by growing away from light sources. When exposed to light, roots curve away from illumination and grow downward in the direction of gravity, showing positive geotropism. Growing away from light directs roots into soil, securing physical anchorage, moisture, and essential mineral nutrients.

171. (B) They orient plant parts toward light and water
Tropic movements provide significant evolutionary advantages by orienting plant growth directionally relative to essential resources. Positive phototropism directs shoots toward light to optimize photosynthetic energy capture, while positive geotropism and hydrotropism guide roots downward into soil toward moisture and minerals required for survival and development.

172. (B) Heliotropism
Heliotropism refers to the diurnal tracking of the sun's movement across the sky by plant structures like sunflower heads. Driven by motor cells in specialized stem regions altering turgor pressure daily, heliotropism allows young floral buds to face east at sunrise and track westward, optimizing light absorption and warming flower tissues.

173. (D) Turgor loss causes rapid leaf drooping
Cell turgor pressure changes directly govern nastic movements in sensitive plants. Upon physical touch, mechanical signals cause rapid efflux of potassium ions and water from pulvinus motor cells. Loss of internal turgor pressure renders these cells flaccid, collapsing structural support and causing rapid leaf drooping without directional growth.

174. (A) Gas exchange and transpiration
Regulated opening and closing of stomatal pores directly governs photosynthetic gas exchange and transpiration. Open stomatal apertures allow carbon dioxide uptake necessary for photosynthetic carbon fixation while permitting transpirational water vapor exit. Guard cells modulate pore size to optimize carbon dioxide gain while minimizing excessive water loss under dry conditions.

175. (A) I and II only
Cytokinins promote active cell division and are concentrated in rapidly growing tissues like developing seeds, fruits, and apical meristems. Rather than accelerating senescence, cytokinins delay leaf aging by maintaining chlorophyll and protein synthesis. Therefore, statements I and II correctly describe cytokinin physiological roles in plants.

176. (B) Fruits will stay green and unripe
Ethylene gas is the essential hormonal signal required for climacteric fruit ripening. In the absence of ethylene production, fruits fail to initiate ripening pathways. Consequently, cell wall softening enzymes, chlorophyll breakdown, and sugar accumulation are halted, leaving fruits continuously firm, green, and unripe on the plant.

177. (C) Fungus
The foolish seedling disease of rice, characterized by excessive stem elongation, led to the discovery of gibberellins. Japanese scientists discovered the disease was caused by infection with the fungal pathogen Gibberella fujikuroi. The fungus secretes abundant gibberellic acid, triggering abnormal internodal elongation in infected host plants.

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178. (A) ABA closes stomata to conserve water
Prolonged water deprivation triggers stress pathways causing roots to synthesize and transport abscisic acid to leaves. Abscisic acid binds guard cell membrane receptors, opening ion channels and causing solute and water loss. Flaccid guard cells close stomata, halting transpiration to prevent desiccation and preserve remaining internal moisture.

179. (C) Hormones act slowly via cell-to-cell diffusion
Plant hormonal communication operates without nervous tissues, blood vessels, or central processing organs. Signals travel slowly through cell-to-cell diffusion, plasmodesmata, or vascular phloem and xylem streams. Responses

50. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Pancreas is known as a mixed gland.
Reason (R): It performs both exocrine and endocrine functions.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

51. Which endocrine gland is located at the base of the brain, just below the hypothalamus?
(A) Pituitary gland
(B) Thyroid gland
(C) Adrenal gland
(D) Pancreas

52. The thyroid gland is anatomically located in the:
(A) Abdomen
(B) Brain
(C) Chest cavity
(D) Neck region

53. Adrenal glands in the human body are located:
(A) Below the stomach
(B) On top of the kidneys
(C) Inside the brain
(D) In the neck

54. The pancreas is situated in the body:
(A) Near the heart
(B) In the pelvic cavity
(C) Just below the stomach
(D) On top of the kidneys

55. The pineal gland is a small endocrine gland located in the:
(A) Chest
(B) Abdomen
(C) Neck
(D) Brain

56. Which of the following is not an endocrine gland?
(A) Sweat gland
(B) Pituitary
(C) Thyroid
(D) Adrenal

57. Identify the pair of hormones that have antagonistic (opposite) effects on blood sugar levels:
(A) Adrenaline and Thyroxine
(B) Insulin and Glucagon
(C) Oestrogen and Progesterone
(D) Growth hormone and Melatonin

58. The hormone responsible for the onset of the menstrual cycle and development of female reproductive organs is:
(A) Testosterone
(B) Oestrogen
(C) Adrenaline
(D) Growth hormone

59. Which gland shrinks in size as an individual ages, reducing its immune function?
(A) Thymus
(B) Thyroid
(C) Pituitary
(D) Pancreas

60. Match the diseases or disorders in List I with their corresponding causes in List II.
List I: (Disease/Disorder)
P. Goitre
Q. Diabetes
R. Dwarfism
S. Gigantism
List II: (Cause)
1. Deficiency of Insulin
2. Excess of Growth Hormone
3. Deficiency of Iodine/Thyroxine
4. Deficiency of Growth Hormone
(A) P-1, Q-3, R-2, S-4
(B) P-4, Q-2, R-1, S-3
(C) P-3, Q-1, R-4, S-2
(D) P-3, Q-4, R-1, S-2

61. The process by which the presence of a specific hormone level inhibits its further release is known as:
(A) Positive feedback
(B) Hormonal imbalance
(C) Chemical breakdown
(D) Negative feedback

62. Which organ acts as the main sensor for blood glucose concentration in the human body?
(A) Liver
(B) Kidney
(C) Pancreas
(D) Stomach

63. Choose the odd one out based on the type of gland:
(A) Sebaceous gland

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190. (A) II, III, I, IV
During seed germination, the radicle emerges first from the seed coat and displays positive geotropism by growing downward into soil. Next, the plumule emerges and exhibits negative geotropism, growing upward toward open air and light. Finally, secondary lateral roots branch off the primary root to expand anchorage.

191. (B) Elongation of cells on the shaded side
Stem curvature toward light occurs because auxin redistributes away from illuminated tissues to the shaded side of the shoot apex. Elevated auxin concentration on the shaded side stimulates faster longitudinal cell elongation relative to the lit side. This differential elongation curves the stem structure directionally toward light.

192. (C) None; it is regulated by Abscisic acid
Stomatal closure during drought is regulated by the non-gaseous hormone abscisic acid rather than atmospheric gases. Synthesized in water-stressed roots and leaves, abscisic acid induces rapid ion efflux from guard cells, causing turgor pressure loss. Flaccid guard cells close stomatal pores, preventing excessive transpirational water loss during dry conditions.

193. (B) Positive chemotropism
Guided growth of the pollen tube through style tissues toward ovary ovules represents positive chemotropism. Synergid cells inside the embryo sac release chemical signals, establishing chemical concentration gradients. The germinating pollen tube senses these chemical cues, directing its growth path precisely toward the micropyle to ensure double fertilization.

194. (B) Slow, chemical, and growth-oriented
Plant coordination operates primarily through chemical signaling via phytohormones and localized turgor shifts. Because plants lack nerves and muscles, responses are characteristically slow, growth-oriented, and mediated through altered rates of cell division and elongation, enabling plants to adapt directionally and physiologically to environmental changes over time.

195. (A) P-2, Q-4, R-1, S-3
Cytokinin promotes rapid cell division across active meristems. Abscisic acid enforces seed dormancy during unfavorable conditions. Gibberellin stimulates stem and internodal elongation. Auxin mediates phototropic cell elongation on the shaded stem side. Correctly pairing each plant hormone with its primary physiological function aligns with plant regulatory mechanisms.

196. (B) Adjust to environmental changes and survive
The biological purpose of coordination in plants is enabling sessile organisms to sense, adapt, and respond effectively to dynamic environmental conditions. By coordinating growth direction, water conservation, seasonal flowering, and stress defenses using phytohormones, plants maximize resource acquisition, optimize survival, and ensure successful reproduction in variable habitats.

197. (C) Transpirational pull of water in xylem
Transpirational pull is a physical, non-hormonal process driven by solar evaporation of water from leaf mesophyll cells, creating physical tension that pulls water upward through dead xylem vessels. In contrast, floral bud opening, fruit abscission, and phototropic bending represent physiological growth and turgor processes actively regulated by phytohormones.

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198. (B) Thigmotropism
A climbing plant coiling around a wire fence illustrates positive thigmotropism. Epidermal touch contact triggers lateral migration of auxin away from the contact surface to the outer non-contact side. Accelerated cell elongation on the outer side curves the tendril or stem around the wire fence, securing physical support.

199. (B) It would wilt and die rapidly in droughts
A plant unable to synthesize abscisic acid fails to close stomata during drought conditions. Without abscisic acid signaling guard cell turgor loss, stomata remain open continuously, leading to uncontrolled transpirational water loss. The resulting severe dehydration causes the plant to wilt and die rapidly during water shortages.

200. (B) Phytohormones
Phytohormones are organic chemical regulators produced naturally within plants in minute concentrations. They control and coordinate physiological processes, including cell division, longitudinal cell expansion, tissue differentiation, organ tropisms, seed dormancy, flowering, and fruit ripening, enabling sessile plants to regulate growth and respond dynamically to environmental stimuli.

P. Pancreas
Q. Thyroid
R. Adrenal
S. Pituitary

List II: (Hormone)

1. Adrenaline
2. Growth hormone
3. Insulin
4. Thyroxine

(A) P-3, Q-1, R-4, S-2
(B) P-3, Q-4, R-1, S-2
(C) P-2, Q-4, R-1, S-3
(D) P-4, Q-3, R-2, S-1

26. Under-secretion of growth hormone during early childhood results in:
(A) Gigantism
(B) Dwarfism
(C) Diabetes
(D) Exophthalmic goitre

27. The thymus gland plays a major role in the development of the:
(A) Immune system
(B) Digestive system
(C) Respiratory system
(D) Excretory system

28. Which hormone is responsible for regulating the body's sleep-wake cycle?
(A) Adrenaline
(B) Thyroxine
(C) Melatonin
(D) Insulin

29. Melatonin is secreted by which of the following glands?
(A) Thymus gland
(B) Pituitary gland
(C) Parathyroid gland
(D) Pineal gland

30. Consider the following statements regarding the feedback mechanism in the human body:
I. It regulates the timing and amount of hormone released.
II. It works to maintain homeostasis.
III. It only operates through the nervous system without chemical involvement.
Which of the above statement(s) is/are correct?
(A) Only II and III
(B) Only I and III
(C) Only I and II
(D) I, II, and III

31. If blood sugar levels fall too low, which hormone's secretion is reduced by the feedback mechanism to prevent further dropping?
(A) Glucagon
(B) Insulin
(C) Adrenaline
(D) Thyroxine

32. The timing and amount of hormone released are controlled by:
(A) The lymphatic system
(B) The skeletal system
(C) Exocrine ducts
(D) Feedback mechanisms

33. Cortisol is often referred to as the:
(A) Stress hormone
(B) Sleep hormone
(C) Growth hormone
(D) Reproductive hormone

34. Long-term elevation of cortisol due to chronic stress can lead to:
(A) Enhancement of overall immune system function
(B) Significant reduction in systemic blood pressure
(C) Weakened immune response and fatigue
(D) Accelerated growth of skeletal muscle tissue

35. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Adrenaline increases the breathing rate during an emergency.
Reason (R): Increased breathing rate supplies more oxygen to the skeletal muscles for rapid action.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

36. Which part of the brain acts as the primary link between the nervous system and the endocrine system?
(A) Cerebellum
(B) Medulla oblongata
(C) Cerebrum
(D) Hypothalamus

37. The hypothalamus controls the secretions of the:
(A) Thyroid gland

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(C) Pineal gland
(D) Thymus gland

12. Adrenaline is secreted by which of the following glands?
(A) Pancreas
(B) Pituitary
(C) Adrenal
(D) Thyroid

13. The hormone adrenaline prepares the body for which of the following responses?
(A) Rest and digest
(B) Sleep and wake cycle
(C) Growth and development
(D) Fight or flight

14. Which physiological change does not occur when adrenaline is secreted into the blood?
(A) The heart beats faster to pump more oxygenated blood
(B) The breathing rate increases to intake additional oxygen
(C) The blood supply to the digestive system increases
(D) The blood supply to skeletal muscles increases rapidly

15. Choose the correct sequence of events when the body faces a sudden stressful situation:
(A) Stress → Pituitary secretes adrenaline → Heart rate decreases → Flight
(B) Stress → Adrenal secretes adrenaline → Blood flow to muscles increases → Action
(C) Stress → Pancreas secretes insulin → Blood sugar drops → Fight
(D) Stress → Thyroid secretes thyroxine → Breathing slows → Rest

16. The pancreas acts as a mixed gland. Its endocrine portion is responsible for secreting:
(A) Digestive enzymes
(B) Bile juice
(C) Thyroxine
(D) Insulin and glucagon

17. The function of insulin in the human body is to:
(A) Decrease blood sugar levels
(B) Increase blood sugar levels
(C) Regulate calcium metabolism
(D) Stimulate growth

18. Diabetes mellitus is a disease caused by the insufficient secretion of which hormone?
(A) Glucagon
(B) Adrenaline
(C) Insulin
(D) Growth hormone

19. What is the role of glucagon in the regulation of blood sugar?
(A) It promotes glycogen breakdown into glucose
(B) It converts excess glucose into stored glycogen
(C) It facilitates the transport of glucose into cells
(D) It inhibits glucose synthesis in liver cells

20. Which of the following is the correct sequence of hormone transport from synthesis to action?
(A) Target cell → Bloodstream → Endocrine gland
(B) Endocrine gland → Duct → Target cell
(C) Bloodstream → Endocrine gland → Target cell
(D) Endocrine gland → Bloodstream → Target cell

21. The male reproductive hormone secreted by the testes is:
(A) Oestrogen
(B) Testosterone
(C) Progesterone
(D) Prolactin

22. Oestrogen and progesterone are primarily secreted by the:
(A) Uterus
(B) Pituitary gland
(C) Ovaries
(D) Adrenal glands

23. Which hormone is essential for the physical growth and development of bones and muscles in children?
(A) Insulin
(B) Glucagon
(C) Melatonin
(D) Growth hormone

24. Over-secretion of growth hormone during childhood leads to a condition called:
(A) Gigantism
(B) Dwarfism
(C) Goitre
(D) Diabetes

25. Match the endocrine glands in List I with their corresponding hormones in List II.
List I: (Endocrine Gland)

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CHAPTER 08

Hormones in Animals

1. The chemical substances secreted by endocrine glands to regulate various body functions are called:
(A) Hormones
(B) Enzymes
(C) Antibodies
(D) Antigens

2. Endocrine glands differ from exocrine glands primarily because endocrine glands:
(A) Secrete substances through a duct
(B) Do not produce chemical messengers
(C) Pour their secretions directly into the blood
(D) Are located only in the brain

3. Which of the following statements best defines a target organ in the endocrine system?
(A) The specific organ or tissue on which a hormone acts
(B) The organ where the hormone is produced
(C) An organ that destroys excess hormones
(D) Any organ that stores hormones for future use

4. Identify the incorrect statement regarding the transport of hormones in the human body.
(A) Hormones are transported via the bloodstream
(B) Hormones travel throughout the body but affect specific tissues
(C) Hormones act as chemical messengers
(D) Hormones are carried by specialized ducts to target organs

5. The pituitary gland is often referred to as the "master gland" because:
(A) It is the largest gland in the body
(B) It controls the activities of many other endocrine glands
(C) It is the only gland that secretes hormones
(D) It regulates the nervous system directly

6. Which of the following hormones is secreted by the thyroid gland?
(A) Adrenaline
(B) Insulin
(C) Thyroxine
(D) Testosterone

7. The primary function of thyroxine in the human body is to:
(A) Regulate blood glucose levels and glucose uptake
(B) Stimulate development of the adaptive immune system
(C) Prepare physiological systems for emergency stress
(D) Regulate carbohydrate, protein, and fat metabolism

8. Iodine is an essential mineral required for the synthesis of which hormone?
(A) Thyroxine
(B) Insulin
(C) Adrenaline
(D) Growth hormone

9. A deficiency of iodine in the diet can lead to a condition characterized by a swollen neck. This disease is known as:
(A) Diabetes
(B) Goitre
(C) Dwarfism
(D) Gigantism

10. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The pituitary gland is called the master gland of the body.
Reason (R): It secretes hormones that regulate the functioning of other endocrine glands.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

11. Which endocrine gland is responsible for regulating calcium and phosphorus balance in the blood?
(A) Parathyroid gland
(B) Thyroid gland

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(B) Pituitary gland
(C) Pancreas
(D) Thymus gland

38. Which of the following is an example of an exocrine gland?
(A) Pituitary gland
(B) Adrenal gland
(C) Salivary gland
(D) Thyroid gland

39. Exocrine glands differ from endocrine glands in that exocrine glands:
(A) Lack ducts
(B) Secrete hormones directly into the blood
(C) Are located only in the abdomen
(D) Secrete their products into ducts

40. Consider the following statements about hormonal control in animals:
I. Hormones are produced by endocrine glands.
II. Hormones are transported by the blood.
III. Hormones act slowly compared to nerve impulses.
IV. Hormonal effects are generally short-lived compared to nervous responses.
Which of the above statement(s) is/are correct?
(A) I, II, and III
(B) II, III, and IV
(C) I, III, and IV
(D) I, II, III, and IV

41. Secondary sexual characteristics in human males during adolescence are primarily triggered by:
(A) Oestrogen
(B) Testosterone
(C) Thyroxine
(D) Insulin

42. Which of the following changes during adolescence is triggered by oestrogen in females?
(A) Deepening and cracking of the voice
(B) Development of mammary glands
(C) Prominent growth of facial hair
(D) Rapid increase in skeletal muscle mass

43. A person is advised to take insulin injections by a doctor. This indicates that the person is suffering from:
(A) Diabetes
(B) Goitre
(C) Gigantism
(D) Dwarfism

44. What is the most common reason for advising the use of iodised salt in the diet?
(A) To prevent diabetes
(B) To enhance height
(C) To prevent goitre
(D) To regulate the sleep cycle

45. Arrange the following events in the correct sequence of the feedback mechanism controlling blood sugar:
I. Release of insulin by pancreas
II. Blood sugar level rises
III. Blood sugar level falls
IV. Cells absorb more glucose
(A) I, II, III, IV
(B) II, IV, I, III
(C) I, IV, II, III
(D) II, I, IV, III

46. Hormones coordinate with the nervous system to perform control and coordination in animals. The nervous system uses electrical impulses, whereas the endocrine system uses:
(A) Mechanical signals
(B) Magnetic fields
(C) Chemical messengers
(D) Acoustic signals

47. Animals often show behavioural changes such as aggression or mating displays. These behaviours are heavily regulated by:
(A) Digestive enzymes
(B) Hormones
(C) Bile juice
(D) Saliva

48. A blood test to measure the level of TSH (Thyroid Stimulating Hormone) is a common testing method used to check the functioning of the:
(A) Pancreas
(B) Adrenal gland
(C) Thymus gland
(D) Thyroid gland

49. In treating hormonal imbalances, replacing the missing hormone is a common method. For a patient with hypothyroidism (underactive thyroid), the treatment typically involves administering:
(A) Synthetic thyroxine
(B) Insulin
(C) Adrenaline
(D) Melatonin

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occur over hours or days via growth alteration, unlike instantaneous electrical nerve impulse transmission characteristic of animal nervous coordination.

180. (C) The stem will grow straight up, unbent.
Phototropic perception occurs at the shoot tip, where light-sensitive phototropins detect light direction. Covering the stem tip with an opaque cap prevents unilateral light from reaching photoreceptors. Lacking light direction detection, auxin remains evenly distributed across the stem, resulting in uniform cell elongation and straight upward growth.

181. (B) Shoot apex
The shoot apex is the primary phototropic region in seedlings. Containing high concentrations of phototropin photoreceptors, the shoot tip senses light direction and establishes an asymmetric auxin gradient. Transporting auxin to the shaded side drives differential stem elongation, causing the shoot tip to bend toward light.

182. (B) The folding of leaves is a growth-related movement.
The rapid folding of leaves in Mimosa pudica is a non-growth nastic movement driven by osmotic water loss and turgor pressure changes within specialized pulvinus cells. Independent of stimulus direction and cell elongation, this reversible response occurs rapidly without permanent structural tissue growth, making statement B incorrect.

183. (B) Geotropism - Response to gravity
Geotropism is correctly defined as the directional growth response of plant organs relative to gravity force gradients. Phototropism responds specifically to light stimuli, hydrotropism represents growth directed by water or moisture gradients, and thigmotropism refers to directional growth in response to physical contact or mechanical touch.

184. (C) Abscisic acid - Maintains seed dormancy
While abscisic acid promotes seed dormancy, seed dormancy regulation involves a balance with gibberellins. Hormonal roles must accurately reflect growth promotion or inhibition context. Abscisic acid functions primarily as a stress hormone and growth inhibitor, interacting dynamically with promoters like gibberellin to govern dormancy breaking and overall plant growth cycles throughout development.

185. (A) I, II, and III
Nastic movements are non-directional plant responses independent of stimulus position, whereas tropic movements are directional growth responses driven by stimulus orientation. Tropisms depend on permanent differential cell growth and division. In contrast, nastic movements in Mimosa pudica rely on reversible turgor pressure changes in pulvinus cells rather than growth.

186. (C) Turgor pressure and rigid cell walls
Lacking skeletal structures or muscular systems, plants rely on rigid cell walls composed of cellulose and internal turgor pressure to maintain upright posture. Water entering vacuolar spaces creates hydrostatic turgor pressure against strong cell walls, providing structural rigidity and mechanical strength needed to support stems, branches, and foliage.

187. (B) Hormonal control of plant growth
Phytoregulation refers broadly to the chemical control and physiological modulation of plant growth and development using phytohormones or synthetic plant growth regulators. Phytoregulators govern key biological processes, including cell division, longitudinal cell elongation, apical dominance, floral induction, fruit ripening, abscission, and physiological stress responses across plant life cycles.

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188. (D) Acting as a mineral fertilizer
Synthetic plant hormones act as regulatory signaling compounds rather than nutrient sources, so they cannot function as mineral fertilizers. Fertilizers supply essential inorganic elements like nitrogen, phosphorus, and potassium required for metabolic synthesis. Synthetic hormones regulate physiological growth processes, such as rooting, weed control, and fruit enlargement.

189. (B) Auxin
Plant growth responses to directional light rely on asymmetrical distribution of auxin. Unilateral light triggers lateral diffusion of auxin from the illuminated side to the shaded side of the shoot tip. Accumulated auxin accelerates cell elongation on the shaded side, bending the stem directionally toward the light source.

(B) Pituitary gland
(C) Tear gland
(D) Salivary gland

64. A boy is running away from a frightening dog. Which hormone is actively facilitating this physical response?
(A) Insulin
(B) Thyroxine
(C) Melatonin
(D) Adrenaline

65. The term 'ductless glands' is used interchangeably with:
(A) Endocrine glands
(B) Exocrine glands
(C) Digestive glands
(D) Lymph nodes

66. How do hormones reach their target tissues once secreted?
(A) Through specific nerves
(B) Along the lymphatic vessels only
(C) Via the bloodstream
(D) Through continuous ducts

67. Which of the following statements about thyroxine is incorrect?
(A) It is produced by the parathyroid glands
(B) It requires iodine for its synthesis
(C) It regulates carbohydrate, protein, and fat metabolism
(D) Its deficiency can cause goitre

68. The secretion of reproductive hormones by the testes and ovaries is primarily controlled by hormones released from the:
(A) Thyroid gland
(B) Adrenal gland
(C) Pancreas
(D) Pituitary gland

69. Parathormone (PTH), secreted by the parathyroid glands, primarily functions to:
(A) Decrease blood calcium levels
(B) Increase blood calcium levels
(C) Regulate body temperature
(D) Stimulate white blood cell production

70. Select the correct order of the levels of biological organization involved in a hormonal response:
(A) Hormone → Gland → Duct → Target Organ → Response
(B) Target Organ → Blood → Hormone → Gland → Response
(C) Gland → Hormone → Blood → Target Organ → Response
(D) Gland → Target Organ → Hormone → Blood → Response

71. In animals, chemical coordination is achieved entirely through:
(A) Enzymes
(B) Vitamins
(C) Minerals
(D) Hormones

72. Which of the following best describes the "fight or flight" response?
(A) An involuntary reaction to perceived danger
(B) A rapid drop in blood pressure to calm the body
(C) A conscious behavioral decision to avoid stress
(D) The biological process of digestion during rest

73. During adolescence, a significant surge in which hormone causes boys to develop facial hair?
(A) Oestrogen
(B) Testosterone
(C) Progesterone
(D) Insulin

74. Which of the following is an example of a disease caused by a hormonal imbalance?
(A) Malaria
(B) Diabetes
(C) Tuberculosis
(D) Typhoid

75. Consider the following statements about the endocrine and nervous systems:
I. The nervous system acts rapidly, while the endocrine system generally acts slowly.
II. Nervous impulses affect specific locations, while hormones can reach all cells in the body via blood.
III. The effects of the nervous system are mostly long-lasting, while hormonal effects are extremely brief.
Which of the above statement(s) is/are correct?
(A) Only I and II
(B) Only II and III
(C) Only I and III
(D) I, II, and III

76. To confirm the diagnosis of diabetes, a doctor typically orders a test to measure the level of:
(A) Hemoglobin

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combat infections
(B) It synthesizes digestive lipases to break down dietary fats
(C) It stores hepatic glycogen reserves for emergency metabolism
(D) It directly regulates overall calcium deposition in skeletal bone

169. Identify the correct pair of a gland and the disorder caused by its malfunction:
(A) Pancreas - Goitre
(B) Thyroid - Goitre
(C) Pituitary - Diabetes
(D) Adrenal - Dwarfism

170. Which of the following sequences represents the correct order of the feedback mechanism when blood sugar levels fall?
(A) Low blood sugar → Pancreas secretes insulin → Cells take up glucose → Blood sugar rises
(B) Low blood sugar → Pancreas secretes glucagon → Liver releases glucose → Blood sugar rises
(C) Low blood sugar → Thyroid secretes thyroxine → Liver breaks down fat → Blood sugar rises
(D) Low blood sugar → Pituitary secretes growth hormone → Muscles release glucose → Blood sugar rises

171. If a person consumes a large amount of sweets, the immediate hormonal response will be an increased secretion of:
(A) Insulin
(B) Glucagon
(C) Adrenaline
(D) Thyroxine

172. The central role of hormones in the regulation of the reproductive process includes:
(A) Regulating systemic rates of pulmonary respiration
(B) Digesting complex carbohydrates within intestine
(C) Initiating puberty and reproductive organ maturation
(D) Maintaining stable core body temperature balance

173. Behavioral changes in animals, such as the metamorphosis of a tadpole into a frog, are controlled by:
(A) Insulin
(B) Adrenaline
(C) Melatonin
(D) Thyroxine

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174. Which of the following is a direct consequence of a hyperactive pituitary gland during the growing years?
(A) The individual will rapidly develop severe chronic diabetes mellitus.
(B) The individual will exhibit prominent cervical swelling from goitre.
(C) The individual will grow exceptionally tall, resulting in gigantism.
(D) The individual will experience precocious and early onset puberty.

175. Consider the following statements about exocrine and endocrine glands:
I. Endocrine glands are ductless.
II. Exocrine glands pour their secretions directly into the blood.
III. Sweat glands and salivary glands are examples of exocrine glands.
IV. Hormones are secreted by exocrine glands.
Which of the above statement(s) is/are correct?
(A) II and IV
(B) I and III
(C) I, II, and III
(D) I, III, and IV

176. Which of the following hormones is not secreted by the pituitary gland?
(A) Growth Hormone
(B) Thyroid Stimulating Hormone
(C) Prolactin
(D) Adrenaline

177. The term 'homeostasis' refers to the maintenance of a stable internal environment. The endocrine system achieves this primarily through:
(A) Positive and negative feedback mechanisms
(B) Constant, unregulated secretion of hormones
(C) Direct physical connection to all body cells
(D) Elimination of hormones via the digestive tract

178. What is the role of testosterone in males?
(A) It stimulates development of female secondary sexual traits during puberty.
(B) It lowers blood sugar concentration by promoting cellular glucose absorption.
(C) It drives development of male reproductive organs and secondary traits.
(D) It regulates the circadian sleep-wake cycle in response to day length.

(D) Complete reversal and curing of diabetes

89. Which of the following correctly pairs the hormone with its primary target organ?
(A) Insulin - Bone matrix and skeletal tissues
(B) TSH - Thyroid gland
(C) Adrenaline - Renal tubules of the kidneys
(D) Growth hormone - Endocrine pancreas tissue

90. Which of the following best explains why the feedback mechanism is essential?
(A) It ensures hormones are continuously secreted into the bloodstream without interruption.
(B) It prevents over-secretion or under-secretion of hormones to maintain balance.
(C) It converts endocrine glands into duct-based exocrine glands whenever necessary.
(D) It completely replaces the central role of the brain in bodily nervous control.

91. The primary structural unit of the thyroid gland involved in the production of thyroxine requires which element from the blood?
(A) Iodine
(B) Iron
(C) Calcium
(D) Potassium

92. Which gland secretes a hormone that plays a major role in the maturation of T-lymphocytes (white blood cells)?
(A) Pineal
(B) Thyroid
(C) Thymus
(D) Pancreas

93. Changes in daylight and darkness affect the secretion of which hormone, thereby regulating sleep patterns?
(A) Insulin
(B) Thyroxine
(C) Adrenaline
(D) Melatonin

94. The condition known as exophthalmic goitre (Graves' disease) is associated with:
(A) Hyposecretion of thyroxine
(B) Hyposecretion of insulin
(C) Hypersecretion of thyroxine
(D) Hypersecretion of insulin

95. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Our diet should include iodised salt.
Reason (R): Iodine is essential for the synthesis of thyroxine, preventing goitre.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

96. Hormones act as chemical messengers. Their highly specific nature means that a hormone:
(A) Operates by traveling exclusively to a single target organ within the entire body
(B) Functions as an active signaling molecule only during the adolescent growth period
(C) Selectively destroys tissue cells that do not currently require metabolic regulation
(D) Binds specifically to cells possessing matching receptors for that hormone

97. The regulation of blood calcium levels is a classic example of endocrine balance. While parathyroid hormone increases blood calcium, which gland is primarily involved in producing hormones that can lower it (calcitonin)?
(A) Thyroid gland
(B) Adrenal gland
(C) Pituitary gland
(D) Thymus gland

98. When a person is frightened, the hormone adrenaline is released in large quantities. Which of the following is not a result of this release?
(A) Dilation of pupils
(B) Increased heart rate
(C) Decreased rate of respiration
(D) Increased blood flow to skeletal muscles

99. A boy observes that his voice is breaking and deepening. This secondary sexual character is brought about by the secretion of:
(A) Testosterone
(B) Adrenaline
(C) Thyroxine
(D) Insulin

100. Arrange the following parts of the endocrine control pathway in correct sequential order from top to bottom structurally:
I. Hypothalamus
II. Pituitary gland
III. Thyroid gland
IV. Adrenal gland

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(A) I, III, II, IV
(B) II, I, IV, III
(C) II, III, I, IV
(D) I, II, III, IV

101. Which of the following is the best description of a hormone?
(A) A vital dietary nutrient that directly provides cellular energy
(B) A chemical messenger secreted into the bloodstream
(C) A specialized digestive enzyme that breaks down complex proteins
(D) A metabolic waste product eliminated by cellular respiration

102. In males, the testes are located outside the abdominal cavity in the scrotum to:
(A) Provide a significantly larger surface area for continuous hormone secretion
(B) Protect delicate reproductive structures from external mechanical shock
(C) Maintain a lower temperature essential for normal sperm formation
(D) Establish a direct structural connection to the nearby adrenal glands

103. The physical changes occurring in females during puberty, such as broadening of the hips and breast development, are primarily controlled by:
(A) Testosterone
(B) Prolactin
(C) Thyroxine
(D) Oestrogen

104. What is the consequence if the feedback mechanism regulating insulin fails and blood sugar levels continue to rise uncontrollably?
(A) The person develops diabetes mellitus
(B) The person develops severe nutritional goitre
(C) The person exhibits severely stunted dwarfism
(D) The person's sleep cycle is disrupted

105. Match the glands in List I with their primary locations in the body in List II.
List I: (Gland)
P. Pituitary
Q. Thyroid
R. Adrenal
S. Thymus
List II: (Location)
1. Upper chest
2. Base of brain
3. Top of kidneys
4. Neck
(A) P-4, Q-2, R-1, S-3
(B) P-2, Q-4, R-3, S-1
(C) P-2, Q-1, R-3, S-4
(D) P-1, Q-3, R-4, S-2

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106. In animal behavior, territorial marking and aggression in males are strongly influenced by the presence of:
(A) Melatonin
(B) Testosterone
(C) Adrenaline
(D) Insulin

107. Which gland acts primarily during childhood and begins to atrophy (shrink) during puberty?
(A) Thymus gland
(B) Thyroid gland
(C) Adrenal gland
(D) Pancreas

108. The main metabolic hormone of the body that controls the rate at which cells burn fuels from food is:
(A) Insulin
(B) Glucagon
(C) Thyroxine
(D) Adrenaline

109. Severe deficiency of which hormone during childhood leads to stunted physical and mental growth (cretinism)?
(A) Adrenaline
(B) Insulin
(C) Melatonin
(D) Thyroxine

110. Consider the following statements regarding the pancreas:
I. It has both exocrine and endocrine tissues.
II. The endocrine part produces insulin and glucagon.
III. The exocrine part pours its secretion into the blood.
Which of the above statement(s) is/are correct?
(A) Only II and III
(B) Only I and III
(C) Only I and II
(D) I, II, and III

111. Which hormone is released in response to low blood calcium levels?
(A) Calcitonin
(B) Parathyroid hormone (PTH)

(C) Thyroxine
(D) Glucagon

112. The master control center of the endocrine system, which receives information from the nervous system and directs responses via the pituitary, is the:
(A) Cerebrum
(B) Medulla
(C) Spinal cord
(D) Hypothalamus

113. One major difference between nervous control and hormonal control is that hormonal control is:
(A) Slower but generally long-lasting
(B) Faster and short-lived
(C) Specific only to muscle cells
(D) Dependent entirely on electrical signals

114. If a person's diet is severely lacking in iodine, which gland's function will be most directly compromised?
(A) Adrenal gland
(B) Pituitary gland
(C) Thyroid gland
(D) Pancreas

115. Arrange the following stages of the fight-or-flight response in the correct physiological sequence:
I. Adrenaline travels through the blood
II. Brain perceives danger
III. Increased heart rate and breathing
IV. Adrenal glands secrete adrenaline
(A) II, IV, I, III
(B) IV, I, II, III
(C) II, I, IV, III
(D) I, II, III, IV

116. Glucagon raises blood sugar levels by promoting the breakdown of which substance stored in the liver?
(A) Starch
(B) Cellulose
(C) Fats
(D) Glycogen

117. Which of the following best defines an endocrine gland?
(A) A gland that releases secretions through ducts onto epithelial surfaces or body cavities
(B) A ductless gland secreting hormones directly into tissue fluid and blood
(C) A gland that synthesizes and secretes specialized digestive enzymes for nutrient breakdown
(D) A lymphoid organ that continuously filters interstitial fluid and traps pathogens

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118. Which statement is true about the action of hormones?
(A) They are needed in large quantities to be effective.
(B) They act at the exact site where they are produced.
(C) They are required in very minute quantities.
(D) They do not involve blood for their transport.

119. A person has a consistently high blood sugar level and is finding sugar in their urine. This indicates a malfunction of the:
(A) Liver
(B) Thyroid
(C) Adrenal gland
(D) Pancreas

120. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The timing and amount of hormones released are regulated by feedback mechanisms.
Reason (R): Feedback mechanisms prevent the harmful effects of excess or deficient hormone levels.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

121. The "fight or flight" response is primarily a joint action of which two systems?
(A) Nervous and Digestive systems
(B) Nervous and Endocrine systems
(C) Respiratory and Excretory systems
(D) Circulatory and Skeletal systems

122. Which of the following is a common sign of hypersecretion of the growth hormone after the growing age (in adults)?
(A) Generalized gigantism due to excessive long bone growth
(B) Acromegaly involving enlarged facial bones and extremities
(C) Pituitary dwarfism characterized by proportional small stature
(D) Congenital cretinism causing severely

(B) Iodine in urine
(C) Blood glucose
(D) White blood cells

77. Which system works alongside the nervous system to coordinate and integrate all activities in the animal body?
(A) Circulatory system
(B) Respiratory system
(C) Excretory system
(D) Endocrine system

78. Which of the following conditions is most likely to result from a hyperactive thyroid gland (hyperthyroidism)?
(A) Pronounced sluggishness and significant weight gain
(B) Excessive bone elongation leading to gigantism
(C) Elevated metabolic rate and weight loss
(D) Stunted physical development leading to dwarfism

79. The hormone that is predominantly involved in ensuring glucose enters the body's cells to produce energy is:
(A) Glucagon
(B) Insulin
(C) Adrenaline
(D) Melatonin

80. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Adrenaline is known as the emergency hormone.
Reason (R): It is secreted rapidly in response to stress and prepares the body for sudden action.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

81. Which of the following is a symptom commonly associated with diabetes mellitus?
(A) Excessive thirst and frequent urination
(B) Significantly increased tolerance to cold temperatures
(C) Abnormally decreased blood sugar concentrations
(D) Pronounced swelling in the anterior neck region

82. Which of the following sets of glands represents only endocrine glands?
(A) Salivary, Sweat, Pituitary
(B) Pancreas, Tear, Adrenal
(C) Thyroid, Pituitary, Adrenal
(D) Liver, Salivary, Thyroid

83. An underactive pituitary gland in a growing child is most likely to cause:
(A) Dwarfism
(B) Mental retardation
(C) Exophthalmic goitre
(D) Diabetes

84. Which gland is anatomically divided into an anterior and a posterior lobe, each secreting different hormones?
(A) Thymus
(B) Parathyroid
(C) Pineal
(D) Pituitary

85. Consider the following statements about the role of hormones in reproduction:
I. Testes secrete testosterone.
II. Ovaries secrete oestrogen.
III. Pituitary gland hormones control the activity of testes and ovaries.
IV. Adrenaline regulates the maturation of gametes.
Which of the above statement(s) is/are correct?
(A) I, II, and IV
(B) I, II, and III
(C) II, III, and IV
(D) I, III, and IV

86. Which hormone is not synthesized by the pituitary gland but is released by it?
(A) Growth hormone
(B) Thyroxine
(C) Insulin
(D) None of the above

87. Cortisol is secreted by which part of the endocrine system?
(A) Adrenal medulla
(B) Pancreas
(C) Thyroid
(D) Adrenal cortex

88. A significant long-term effect of high cortisol levels due to chronic stress is:
(A) Impairment of the immune response
(B) Permanent increase in adult height
(C) Significant gain in total bone density

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ingestion
(D) Stimulate emergency fight or flight responses

134. Identify the incorrect pair regarding the gland and its secretion:
(A) Adrenal - Cortisol
(B) Pancreas - Insulin
(C) Thyroid - Growth hormone
(D) Ovary - Oestrogen

135. Choose the correct sequence of the flow of biological information in the endocrine system:
(A) Hormone → Stimulus → Target Tissue → Endocrine Gland → Response
(B) Stimulus → Target Tissue → Hormone → Endocrine Gland → Response
(C) Endocrine Gland → Stimulus → Target Tissue → Hormone → Response
(D) Stimulus → Endocrine Gland → Hormone → Target Tissue → Response

136. Ovaries produce female gametes (ova) as well as hormones. This makes the ovary a:
(A) Primary gonadal organ possessing endocrine activity
(B) Exclusively endocrine gland lacking exocrine structures
(C) Exclusively exocrine gland discharging products via ducts
(D) Specialized lymphatic organ filter for fluid balance

137. Which statement accurately contrasts exocrine and endocrine glands?
(A) Endocrine glands feature specialized secretion ducts, whereas exocrine glands lack ductal pathways entirely.
(B) Endocrine glands secrete directly into blood, while exocrine glands release onto surfaces or cavities.
(C) Exocrine glands secrete systemic regulatory hormones, whereas endocrine glands produce local digestive enzymes.
(D) Endocrine glands are located exclusively in cranial structures, whereas exocrine glands occur only in abdomen.

138. The physiological changes associated with adolescence in both boys and girls are initiated by hormones produced by the:
(A) Gonadal glands (testes and ovaries)
(B) Lymphoid thymus gland in the chest cavity
(C) Melatonin-secreting pineal gland in brain
(D) Calcium-regulating parathyroid glands

139. A patient is observed to have a greatly enlarged neck, fatigue, and weight changes. A doctor suspects a deficiency in the diet. The deficiency is most likely of:
(A) Iodine
(B) Iron
(C) Calcium
(D) Vitamin C

140. Consider the following hormones:
I. Growth Hormone
II. Thyroid Stimulating Hormone
III. Adrenaline
IV. Melatonin
Which of the above hormones is/are secreted by the pituitary gland?
(A) II and III
(B) I, II, and III
(C) I and II
(D) I, III, and IV

141. The hormone that helps in maintaining pregnancy and is produced by the corpus luteum in the ovary is:
(A) Thyroxine
(B) Glucagon
(C) Adrenaline
(D) Progesterone

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142. A sudden surge of adrenaline will lead to:
(A) Significant decrease in overall respiration rate
(B) Enhanced digestive motility and enzyme secretion
(C) Dilation of bronchioles for higher oxygen intake
(D) Rapid lowering of systemic arterial blood pressure

143. Which of the following is not a symptom of severe iodine deficiency?
(A) Goitre
(B) Gigantism
(C) Mental retardation in infants
(D) Delayed physical development

144. Cortisol helps the body manage stress by:
(A) Rapidly accelerating heart rate during immediate alarm states
(B) Inducing deep sleep cycles by suppressing brain activity
(C) Inhibiting all digestive system operations permanently
(D) Regulating metabolism and inflammation

stunted development

123. The function of the pineal gland is closely associated with:
(A) Regulating the biological clock and sleep cycle
(B) Maintaining blood sugar levels within normal ranges
(C) Regulating calcium and phosphate balance in plasma
(D) Promoting immune cell maturation and development

124. The hypothalamus secretes releasing hormones (like GHRH) which directly stimulate the:
(A) Thyroid gland
(B) Adrenal gland
(C) Pituitary gland
(D) Thymus gland

125. Consider the following statements about common hormone testing and treatment:
I. Blood tests are used to determine hormone levels.
II. Insulin injections are given to patients with diabetes.
III. Thyroxine pills are given to treat hypothyroidism.
IV. Hormonal imbalances cannot be medically treated.
Which of the above statement(s) is/are correct?
(A) II, III, and IV
(B) I, III, and IV
(C) I, II, and IV
(D) I, II, and III

126. A 10-year-old child exhibits extremely stunted physical growth. Which hormone deficiency is most likely responsible?
(A) Thyroxine
(B) Adrenaline
(C) Growth hormone
(D) Insulin

127. Which endocrine gland is located in the upper chest region behind the sternum?
(A) Pineal
(B) Thymus
(C) Thyroid
(D) Pituitary

128. Why are hormones termed "chemical messengers"?
(A) Because they transmit fast electrical signals across specialized nerve networks
(B) Because they broadcast high-frequency mechanical vibration signals to cells
(C) Because they directly build and repair structural proteins in skeletal muscle
(D) Because they transmit chemical signals between cell groups

129. The excessive accumulation of sugar in the blood due to lack of insulin is medically termed as:
(A) Hyperglycemia
(B) Hypoglycemia
(C) Hyperthyroidism
(D) Hypothyroidism

130. Consider the following hormones:
I. Adrenaline
II. Thyroxine
III. Insulin
Which of the above hormones are involved in controlling metabolic rate or blood sugar?
(A) Only I and II
(B) Only I and III
(C) Only II and III
(D) I, II, and III

131. Which of the following correctly describes the relationship between the nervous system and the endocrine system?
(A) The nervous system can stimulate or inhibit the release of hormones.
(B) They function completely independently of each other.
(C) The endocrine system acts as the rapid response unit, while the nervous system is slow.
(D) Only the endocrine system regulates body temperature.

132. During an emergency, which blood vessels are likely to constrict due to adrenaline to redirect blood to muscles?
(A) Blood vessels supplying the active skeletal muscles
(B) Coronary blood vessels supplying the heart muscle
(C) Pulmonary blood vessels within the lung tissues
(D) Blood vessels of skin and digestive organs

133. The main role of the parathyroid glands is to:
(A) Regulate sleep-wake cycles and circadian rhythm
(B) Increase calcium levels in the bloodstream
(C) Decrease blood glucose levels after meal

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digestion of food in stomach
(B) Continuous filtration of metabolic waste from blood by kidneys
(C) Neural detection of stress triggering adrenal hormone release
(D) Alveolar gas exchange of oxygen and carbon dioxide in lungs

157. The primary reason a doctor advises checking a patient's fasting blood sugar is to assess the function of the:
(A) Thyroid gland
(B) Adrenal gland
(C) Pituitary gland
(D) Pancreas

158. Dwarfism in humans is a condition resulting from the under-secretion of:
(A) Thyroxine secreted by the thyroid gland
(B) Adrenaline produced by the adrenal medulla
(C) Growth hormone released by pituitary gland
(D) Insulin synthesized by pancreatic beta cells

159. Which hormone triggers the development of mammary glands during female puberty?
(A) Adrenaline
(B) Oestrogen
(C) Glucagon
(D) Melatonin

160. Match the hormones in List I with their specific functions in List II.
List I: (Hormone)
P. Melatonin
Q. Thyroxine
R. Insulin
S. Adrenaline
List II: (Function)
1. Lowers blood glucose
2. Regulates sleep cycle
3. Prepares body for emergency
4. Regulates basal metabolism
(A) P-4, Q-2, R-1, S-3
(B) P-2, Q-1, R-4, S-3
(C) P-1, Q-3, R-2, S-4
(D) P-2, Q-4, R-1, S-3

161. The release of thyroxine from the thyroid gland is stimulated by TSH. Which gland secretes TSH?
(A) Pituitary gland
(B) Hypothalamus
(C) Parathyroid gland
(D) Thymus

162. How does the body ensure that the correct amount of hormone is secreted?
(A) Through voluntary control by the brain
(B) By destroying the endocrine gland after one use
(C) By the feedback mechanism
(D) By secreting all hormones continuously at a constant rate

163. The primary target organ for the action of glucagon is the:
(A) Liver
(B) Heart
(C) Kidneys
(D) Lungs

164. What would happen if a person's adrenal glands failed to secrete adrenaline during a life-threatening emergency?
(A) The individual would rapidly develop pronounced goitre symptoms
(B) The individual's blood glucose levels would instantly drop to zero
(C) The individual would immediately experience deep, sudden sleep
(D) The individual's body would fail to prepare for emergency action

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165. The chemical class of hormones includes proteins, peptides, and steroids. Which of the following is an example of a steroid hormone?
(A) Insulin
(B) Testosterone
(C) Adrenaline
(D) Growth hormone

166. A child is diagnosed with cretinism (stunted physical and mental growth). This disorder is caused by the hyposecretion of:
(A) Growth hormone
(B) Insulin
(C) Thyroxine
(D) Parathormone

167. Which of the following represents the most appropriate treatment for severe diabetes mellitus?
(A) Iodine supplements
(B) Adrenaline injections
(C) Removal of the thyroid gland
(D) Insulin injections

168. Which of the following best describes the function of the thymus gland in the human body?
(A) It promotes immune cell maturation to

over extended periods

145. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Hormones are required in very small amounts by the body.
Reason (R): They act as catalysts and remain unchanged in the blood permanently.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

146. Which part of the body is often called a link between the nervous system and the endocrine system?
(A) Cerebellum
(B) Spinal cord
(C) Hypothalamus
(D) Adrenal medulla

147. Diabetes insipidus is different from diabetes mellitus. It is related to the hormone vasopressin (ADH) secreted by the:
(A) Pituitary gland
(B) Pancreas
(C) Adrenal gland
(D) Thyroid gland

148. Arrange the following glands in order from the uppermost part of the human body to the lowest:
I. Adrenal
II. Thyroid
III. Pineal
IV. Pancreas
(A) III, II, I, IV
(B) II, III, IV, I
(C) II, III, I, IV
(D) III, II, IV, I

149. The coordinated functioning of the endocrine system relies heavily on the blood to:
(A) Break down circulating hormones immediately after release
(B) Transport hormones rapidly to target tissue receptors
(C) Store secreted hormones until metabolic demands arise
(D) Synthesize and produce regulatory hormones directly

150. Which hormone plays a significant role in reducing the body's immune response when chronically elevated due to stress?
(A) Thyroxine
(B) Insulin
(C) Cortisol
(D) Glucagon

151. When insulin is injected into a diabetic patient, it immediately:
(A) Permanently restores healthy pancreatic tissue function
(B) Directly stimulates glucagon production in liver cells
(C) Rapidly elevates blood glucose to normal resting levels
(D) Helps cells absorb glucose to lower blood sugar

152. Adrenaline affects the heart directly. The target cells in the heart respond by:
(A) Contracting faster to pump blood
(B) Contracting less forcefully during systole
(C) Storing excess circulating glucose as glycogen
(D) Releasing bound oxygen into the arterial blood

153. A major characteristic of hormones is that they:
(A) Provide energy to the body
(B) Act on specific target organs
(C) Are always proteins in nature
(D) Are secreted in large amounts like bile

154. The disease diabetes mellitus is a classic example of:
(A) A contagious viral infection of the gut
(B) A disorder caused by endocrine imbalance
(C) A chronic bacterial infection of the blood
(D) A degenerative nervous system failure

155. Consider the following statements about the thyroid gland:
I. It is situated in the neck region.
II. It secretes thyroxine which controls basal metabolic rate.
III. It regulates the body's sleep cycle.
Which of the above statement(s) is/are correct?
(A) Only I and II
(B) Only II and III
(C) Only I and III
(D) I, II, and III

156. An example of mutual coordination between the nervous system and the endocrine system is:
(A) Mechanical breakdown and enzymatic

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179. The hormone that causes the uterus lining to thicken in preparation for a possible pregnancy is:
(A) Progesterone
(B) Adrenaline
(C) Thyroxine
(D) Glucagon

180. Consider the following statements about adrenaline:
I. It is secreted by the adrenal glands.
II. It increases blood flow to the digestive system.
III. It increases the breathing rate.
Which of the above statement(s) is/are correct?
(A) Only I and II
(B) Only II and III
(C) I, II, and III
(D) Only I and III

181. A student observes that a dog gets angry, barks, and prepares to fight when a stranger enters the house. Which internal chemical is surging in the dog to cause this behavioral and physical response?
(A) Insulin
(B) Adrenaline
(C) Thyroxine
(D) Melatonin

182. Choose the correct sequence of action for a hormone targeting a specific cell:
(A) Binding to receptor → Release into blood → Cellular response
(B) Cellular response → Release into blood → Binding to receptor
(C) Release into blood → Binding to specific receptor on target cell → Cellular response
(D) Release into duct → Cellular response → Binding to receptor

183. If the parathyroid glands are accidentally removed during a thyroid surgery, the patient may suffer from severe muscle spasms due to a drop in:
(A) Blood glucose
(B) Blood iron
(C) Blood iodine
(D) Blood calcium

184. The coordination between the nervous and endocrine systems is essential for survival. If the eyes see a snake, the brain interprets the danger and signals the adrenal gland via:
(A) Direct nerve signals to the adrenal medulla
(B) Circulating hormones transported through the bloodstream
(C) Specialized digestive enzymes secreted by the pancreas
(D) Lymphatic fluid moving slowly through tissue channels

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185. Arrange the following events to describe the body's response to an increase in blood glucose levels:
I. Blood glucose level returns to normal
II. Pancreas detects high glucose
III. Insulin is secreted into the blood
IV. Cells absorb more glucose
(A) III, II, IV, I
(B) II, III, IV, I
(C) IV, III, II, I
(D) II, IV, III, I

186. Which hormone must be present in sufficient quantities in the water for tadpoles to successfully undergo metamorphosis into adult frogs?
(A) Adrenaline
(B) Thyroxine
(C) Insulin
(D) Growth hormone

187. The summary of the complete endocrine system functioning suggests that:
(A) The endocrine network coordinates internal bodily balance
(B) Hormones function entirely independently without regulatory interactions
(C) Endocrine glands operate exclusively during acute physical emergencies
(D) The central nervous system plays no active role in endocrine control

188. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Patients with severe diabetes are given insulin injections.
Reason (R): Insulin increases the blood sugar level to provide instant energy.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

ANSWERS

1. (A) Hormones
Endocrine glands are ductless structures in the human body that synthesize and release specialized chemical messengers directly into the blood circulation. These chemical messengers are known as hormones. They travel through the bloodstream to specific target tissues or organs where they bind to specialized receptors, regulating essential physiological processes, cellular growth, metabolism, and organ functions.

2. (C) Pour their secretions directly into the blood
Glands in the human body are broadly categorized as either exocrine or endocrine based on their mode of secretion. Exocrine glands possess specific ducts through which their secretions are released onto epithelial surfaces. Conversely, endocrine glands lack duct systems completely and release their chemical products directly into the surrounding blood vessels for systemic distribution throughout the body.

3. (A) The specific organ or tissue on which a hormone acts
Hormones are transported indiscriminately throughout the entire vascular network after secretion by endocrine glands. However, they exert physiological effects only on specific organs or tissues equipped with complementary hormone receptors. These specific structures are designated as target organs, where hormone binding triggers precise cellular biochemical responses, altering metabolic pathways and maintaining homeostatic cellular balance.

4. (D) Hormones are carried by specialized ducts to target organs
Hormones are chemical signaling molecules produced by ductless endocrine glands. Because these glands do not contain anatomical ducts, hormones are released directly into interstitial fluid and blood capillaries. The circulatory system carries them throughout the body to reach responsive target tissues. Specialized ducts are characteristic of exocrine secretions rather than hormonal transport pathways in the human endocrine system.

5. (B) It controls the activities of many other endocrine glands
The pituitary gland is located at the base of the brain and secretes numerous trophic hormones. These hormones stimulate and regulate the physiological activities of various peripheral endocrine glands, including the thyroid, adrenal cortex, and gonads. Because it exercises overarching regulatory control over the overall endocrine network, it is commonly designated as the master gland of the human body.

6. (C) Thyroxine
The thyroid gland is a butterfly-shaped endocrine organ located in the anterior neck region. It synthesizes and secretes thyroxine, also known as tetraiodothyronine or T4. Thyroxine plays a central physiological role in regulating the baseline rate of metabolism in body tissues, influencing heat production, protein synthesis, and cellular energy expenditure throughout human development.

7. (D) Regulate carbohydrate, protein, and fat metabolism
Thyroxine acts on almost all metabolic tissues across the body to maintain proper tissue differentiation and energy balance. It regulates the basal metabolic rate by controlling how cells process and utilize carbohydrates, proteins, and fats. This systemic influence ensures optimal energy production, body growth, temperature regulation, and proper tissue maintenance under normal biological operating conditions.

8. (A) Thyroxine
Thyroxine synthesis within follicular cells of the thyroid gland requires dietary iodine intake. Iodine atoms are actively absorbed from circulating blood and incorporated into the amino acid tyrosine to produce thyroid hormones. Without adequate iodine availability, the thyroid gland cannot synthesize functional thyroxine, leading to diminished systemic hormone levels and potential enlargement of the gland tissue.

9. (B) Goitre
Dietary iodine deficiency impairs the normal production of thyroxine by thyroid follicular

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2. Requires Iodine
3. Mixed gland
4. Gland of emergency

(A) P-1, Q-2, R-3, S-4
(B) P-4, Q-3, R-2, S-1
(C) P-2, Q-1, R-4, S-3
(D) P-4, Q-1, R-2, S-3

197. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Adrenaline increases blood flow to the digestive system during an emergency.
Reason (R): Digestion requires a lot of energy, which is needed during a fight or flight situation.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

198. Arrange the sequence of hormonal action during puberty in males:
I. Development of secondary sexual characters (e.g., facial hair)
II. Pituitary gland releases stimulating hormones
III. Testes secrete testosterone
IV. Hypothalamus signals the pituitary

(A) II, IV, I, III
(B) I, II, III, IV
(C) IV, II, III, I
(D) IV, III, II, I

199. What would be the most direct consequence if the pineal gland stopped functioning properly?
(A) The person would lose the capacity to digest dietary fats
(B) The person would immediately develop severe gigantism
(C) The person's blood sugar level would become fatally elevated
(D) The person's sleep-wake cycle would be severely disrupted

200. The combined role of the nervous system and the hormonal system in animal coordination ensures that:
(A) The body responds to emergencies while maintaining stability
(B) All physiological responses to environmental stimuli become extremely slow and delayed
(C) Fast electrical impulses completely replace functional blood circulation throughout tissues
(D) Only central nervous brain tissue receives complete anatomical protection against disease

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structures are ductless endocrine glands that release internal regulatory hormones directly into blood circulation.

57. (B) Insulin and Glucagon
Insulin and glucagon exert opposing physiological effects on blood glucose concentrations to maintain glycemia within normal limits. Beta cells secrete insulin when blood glucose is high, promoting glucose absorption and glycogen synthesis to lower blood sugar. Alpha cells release glucagon when sugar levels drop, stimulating hepatic glycogen breakdown. These paired antagonistic hormones regulate homeostasis.

58. (B) Oestrogen
Oestrogen is a primary female sex steroid hormone synthesized by developing ovarian follicles. During female puberty, elevated oestrogen levels stimulate the maturation of reproductive organs, including the uterus, fallopian tubes, and vagina. It also drives the development of secondary female sexual characteristics and initiates cyclic changes in the uterine lining required for menstruation.

59. (A) Thymus
The thymus gland is maximally active and prominent during infancy and early childhood, serving as the site for T-lymphocyte maturation and immune programming. Following puberty, the thymus undergoes progressive involution, gradually shrinking in size and replacing functional lymphatic tissue with adipose tissue. This age-related atrophy leads to reduced production of naive T-cells in older individuals.

60. (C) P-3, Q-1, R-4, S-2
Goitre results from dietary iodine deficiency or impaired thyroxine production. Diabetes mellitus is caused by insufficient insulin secretion by pancreatic cells. Dwarfism in children arises from deficient growth hormone production during growth periods. Gigantism develops when the pituitary gland secretes excess growth hormone prior to epiphyseal plate closure, establishing the exact matched pathological relationships.

61. (D) Negative feedback
Negative feedback is a fundamental self-regulating biological mechanism in which an increase in output or circulating product suppresses its own initial production pathway. In the endocrine system, rising blood concentrations of a hormone or its metabolic result signal back to suppressing glands, halting further secretion and maintaining chemical conditions within healthy physiological parameters.

62. (C) Pancreas
The pancreas functions as the primary sensor for monitoring systemic blood glucose concentration. Specialized endocrine cells within pancreatic Islets of Langerhans continuously detect fluctuating blood sugar levels passing through pancreatic capillaries. Beta cells respond to high glucose by releasing insulin, while alpha cells detect falling glucose levels and release glucagon, coordinating precise glycemic control.

63. (B) Pituitary gland
Sebaceous glands, tear glands, and salivary glands are all exocrine glands equipped with specialized ducts that transport their products onto external or internal body surfaces. The pituitary gland is distinct because it is a ductless endocrine gland that releases regulatory hormones straight into the bloodstream to act on distant internal target tissues.

64. (D) Adrenaline
Fright and acute danger trigger immediate sympathetic nervous activation, prompting the adrenal medulla to release adrenaline into circulation. Adrenaline increases cardiac output, elevates breathing rate, dilates blood vessels supplying leg skeletal muscles, and mobilizes glycogen into blood glucose. These biological responses supply extra oxygen and energy to enable fast physical running during perceived danger.

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65. (A) Endocrine glands
Endocrine glands are termed ductless glands because they lack specialized tubular structures for carrying secretions to target sites. Instead of utilizing ducts, endocrine cells release synthesized chemical messengers directly into surrounding extracellular space, where they diffuse into capillary blood networks for systemic transportation throughout the organism to reach distant responsive target tissues.

66. (C) Via the bloodstream
After being synthesized and secreted by ductless endocrine glands, hormones diffuse through interstitial fluid into nearby capillary blood vessels. The circulatory system carries these circulating hormones throughout the entire body

tissue. In response to persistently low thyroid hormone levels, the anterior pituitary secretes excess thyroid-stimulating hormone to encourage hormone production. This continuous stimulation causes hypertrophy and enlargement of the thyroid gland, resulting in a visible neck swelling clinically identified as goitre.

10. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
The pituitary gland releases several trophic hormones, such as thyroid-stimulating hormone and adrenocorticotropic hormone, into the bloodstream. These tropic factors target other major endocrine glands to direct their secretion rates and physiological functions. Because this tropic regulation forms the functional basis for designating it as the master gland, both statements are correct and logically connected.

11. (A) Parathyroid gland
The parathyroid glands consist of four tiny glands located on the posterior surface of the thyroid gland. They secrete parathyroid hormone, which acts on bone tissue, kidneys, and the intestinal tract. Through these actions, parathyroid hormone increases blood calcium concentration and regulates phosphate homeostasis, ensuring proper neuromuscular functioning and mineral density in bones.

12. (C) Adrenal
Adrenaline, also referred to as epinephrine, is produced and released by the adrenal medulla, which forms the inner core of the paired adrenal glands located atop each kidney. Secretion increases dramatically during conditions of physical stress, fear, or perceived danger, mobilizing metabolic energy reserves and adjusting systemic circulatory dynamics for immediate emergency responses.

13. (D) Fight or flight
During sudden stress or acute danger, adrenaline is rapidly released into the circulatory system to trigger physiological adjustments. It accelerates heart rate, elevates arterial blood pressure, dilates respiratory pathways, and diverts blood flow away from non-essential organs toward skeletal muscles. These integrated changes collectively prepare the physical body for an immediate fight-or-flight response.

14. (C) The blood supply to the digestive system increases
During emergency stress, adrenaline release causes selective vasoconstriction in non-essential organs such as the digestive tract and skin. This mechanism reduces blood flow to the digestive system and diverts circulating blood primarily toward skeletal muscles, heart tissue, and the central nervous system. Digestive activity is temporarily suppressed to prioritize immediate physiological survival mechanisms.

15. (B) Stress → Adrenal secretes adrenaline → Blood flow to muscles increases → Action
When a stressful stimulus is detected, the nervous system prompts the adrenal glands to secrete adrenaline into the blood stream. Circulating adrenaline causes cardiac acceleration and vasodilation in skeletal muscle blood vessels, dramatically increasing muscular blood flow. This systemic preparation enables the physical body to execute rapid, high-energy muscular actions to manage acute threats.

16. (D) Insulin and glucagon
The pancreas functions as a dual exocrine and endocrine organ. Its exocrine portion secretes digestive enzymes into ducts, whereas its endocrine portion consists of pancreatic islets known as the Islets of Langerhans. These specialized endocrine cell clusters synthesize and secrete hormones, primarily insulin and glucagon, directly into the blood to regulate systemic glucose levels.

17. (A) Decrease blood sugar levels
Insulin is an essential anabolic hormone secreted by pancreatic beta cells in response to elevated blood glucose concentrations. It lowers blood sugar levels by promoting cellular glucose absorption in muscle and adipose tissues, while simultaneously stimulating the liver to store excess glucose as glycogen. These actions maintain blood glucose within narrow physiological limits after meals.

18. (C) Insulin
Diabetes mellitus is a metabolic disorder characterized by persistent hyperglycemia resulting from inadequate insulin production by pancreatic beta cells or diminished cellular responsiveness to insulin. Lacking sufficient functional insulin, body tissues cannot effectively absorb glucose from blood circulation, leading to abnormally high blood glucose concentrations,

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urinary glucose excretion, and metabolic complications.

19. (A) It promotes glycogen breakdown into glucose
Glucagon is synthesized and released by pancreatic alpha cells when blood glucose concentration falls below normal physiological levels. It targets liver hepatocytes, where it stimulates glycogenolysis, the enzymatic breakdown of stored glycogen into glucose molecules. This released glucose enters the circulatory system, restoring normal blood sugar levels during fasting or between dietary meals.

20. (D) Endocrine gland → Bloodstream → Target cell
Hormones are produced within specialized cells of ductless endocrine glands. Once synthesized, they diffuse into adjacent capillary beds and travel through the circulatory bloodstream across the body. Upon reaching target tissues containing specific complementary cell surface or intracellular receptors, hormones bind to these receptors, initiating intracellular signaling cascades and eliciting biological responses.

21. (B) Testosterone
Testosterone is the principal androgenic steroid hormone secreted by the Leydig cells of the testes in human males. Its production increases dramatically during puberty, driving the development of primary and secondary male sexual characteristics, including muscle enlargement, facial hair growth, voice deepening, and the regulation of ongoing spermatogenesis within testicular seminiferous tubules.

22. (C) Ovaries
The ovaries represent the primary female reproductive glands responsible for producing female gametes and key steroid hormones. Ovarian follicles secrete oestrogen, which regulates secondary female sexual characteristics and uterine endometrial proliferation. Following ovulation, the corpus luteum within the ovary secretes progesterone, which prepares and maintains the uterine lining for potential embryo implantation.

23. (D) Growth hormone
Growth hormone, secreted by the anterior pituitary gland, plays a critical role in human physical development during childhood and adolescence. It stimulates cell division, protein synthesis, and tissue elongation, particularly targeting epiphyseal cartilage in long bones and skeletal muscle tissue. Proper secretion ensures normal linear bone lengthening, skeletal development, and structural organ growth.

24. (A) Gigantism
Hypersecretion of growth hormone during childhood, prior to the fusion of epiphyseal growth plates in long bones, results in a clinical condition termed gigantism. Excess circulating growth hormone causes exaggerated elongation of skeletal bones and excessive tissue proliferation, causing affected individuals to attain exceptional height and larger body dimensions compared to average physical norms.

25. (B) P-3, Q-4, R-1, S-2
Pancreatic islets produce insulin to lower blood glucose levels. The thyroid gland synthesizes thyroxine to regulate baseline metabolic activities. The adrenal glands produce adrenaline to prepare the body for emergency situations. The anterior pituitary gland secretes growth hormone to stimulate overall tissue growth and development, establishing the accurate functional pairs between glands and hormones.

26. (B) Dwarfism
Hyposecretion of growth hormone during infancy and early childhood severely impairs cell division and long bone lengthening. This deficiency results in pituitary dwarfism, a condition characterized by abnormally short stature and delayed physical development. Despite reduced body height, physical body proportions and cognitive development usually remain normal if thyroid hormone levels are adequate.

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27. (A) Immune system
The thymus gland is a specialized lymphoid organ situated in the upper thoracic cavity behind the sternum. It secretes thymosin hormones that facilitate the maturation and differentiation of T-lymphocytes, essential white blood cells responsible for cell-mediated immunity. Through this functional processing, the thymus establishes crucial immunological defense mechanisms during early development.

28. (C) Melatonin
Melatonin is an amine hormone produced and released by the pineal gland in response to darkness. It plays a central role in governing

circadian rhythms, establishing normal sleep-wake cycles, and signaling environmental light-dark patterns to body tissues. High nocturnal levels induce drowsiness, whereas daylight suppresses synthesis, maintaining synchronized biological body rhythms.

29. (D) Pineal gland
The pineal gland is a small, pinecone-shaped neuroendocrine structure situated in the epithalamus near the center of the brain. It contains specialized pinealocytes that synthesize melatonin from serotonin. Secretion is modulated by light exposure registered by the eyes, allowing the pineal gland to regulate circadian cycles and daily physiological sleep patterns.

30. (C) Only I and II
Feedback mechanisms govern endocrine functions by controlling hormone timing and release amounts based on internal conditions. These self-regulating loops adjust secretion rates to restore biological equilibrium, maintaining homeostasis across organ systems. Because feedback regulation relies on chemical messengers transported in circulation rather than purely nervous connections, the statements describing timing, quantity, and homeostatic control are correct.

31. (B) Insulin
When blood glucose levels drop below normal, pancreatic beta cells detect the change and reduce insulin secretion through negative feedback mechanisms. Decreasing insulin levels slows down cellular glucose uptake and glycogen synthesis. Simultaneously, glucagon secretion increases to mobilize stored glucose, collectively preventing hypoglycemic episodes and preserving stable blood sugar concentrations for cellular respiration.

32. (D) Feedback mechanisms
Endocrine regulation relies on feedback mechanisms to continuously monitor physiological parameters and adjust hormone secretion rates accordingly. When a hormone alters a target tissue parameter, the resulting change signals back to the endocrine gland to suppress or enhance hormone synthesis. This controlled feedback prevents excess hormone accumulation and protects the body against physiological imbalances.

33. (A) Stress hormone
Cortisol is a glucocorticoid steroid hormone secreted by the adrenal cortex in response to physical or psychological stress. It plays an essential role in mobilizing energy stores by increasing blood glucose through gluconeogenesis, regulating fat and protein metabolism, and dampening inflammatory responses. Due to its elevated secretion during stress conditions, it is called the stress hormone.

34. (C) Weakened immune response and fatigue
Prolonged elevation of cortisol caused by persistent stress exerts adverse effects on physiological systems. Sustained high cortisol levels suppress pro-inflammatory signaling and antibody production, compromising immune defenses and increasing infection risk. Additionally, altered carbohydrate metabolism and persistent muscle protein breakdown lead to metabolic exhaustion, physical fatigue, arterial hypertension, and impaired cellular tissue repair processes.

35. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Adrenaline release during emergency situations causes contraction of intercostal muscles and diaphragm acceleration, increasing respiratory rate and dilating airway passages. This physiological adjustment enhances alveolar gas exchange, ensuring that circulating blood receives elevated oxygen supplies. Oxygen-rich blood is delivered rapidly to active skeletal muscles, satisfying increased metabolic demands necessary for immediate emergency survival actions.

36. (D) Hypothalamus
The hypothalamus, located at the base of the brain, serves as the central integrating bridge between the nervous and endocrine systems. It processes neural inputs from sensory pathways and responds by synthesizing releasing and inhibiting hormones. These hypothalamic neurohormones act directly on the adjacent pituitary gland, governing pituitary hormone release and controlling systemic endocrine activity.

37. (B) Pituitary gland
The hypothalamus exercises direct anatomical and functional control over the pituitary gland. It synthesizes releasing and inhibiting factors

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transported through the hypophyseal portal system to the anterior pituitary, directing the synthesis and release of tropic hormones. Additionally, hypothalamic neurosecretory cells produce oxytocin and vasopressin, which are stored in and released from the posterior pituitary.

38. (C) Salivary gland
Salivary glands are exocrine glands that synthesize saliva containing digestive enzymes like salivary amylase. They feature specialized duct systems that transport and discharge these digestive secretions directly into the oral cavity rather than into the bloodstream. In contrast, ductless endocrine glands secrete regulatory hormones straight into systemic blood circulation without using anatomical ducts.

39. (D) Secrete their products into ducts
The key structural distinction between exocrine and endocrine glands lies in the presence or absence of conducting ducts. Exocrine glands possess specialized epithelial ducts that convey secretions, such as sweat, saliva, or digestive enzymes, directly to specific target surfaces or internal cavities. Endocrine glands lack ducts completely, releasing hormones directly into surrounding blood circulation.

40. (A) I, II, and III
Hormones are produced by ductless endocrine glands and transported throughout the body via blood circulation. Because hormonal signaling involves chemical diffusion, blood transport, and cellular receptor binding, its onset is typically slower than rapid nerve impulse transmission, but its physiological effects persist longer. Statements regarding hormone origin, blood transport, and relative action speed accurately describe endocrine control.

41. (B) Testosterone
During male pubertal development, increased luteinizing hormone secretion stimulates testicular Leydig cells to produce elevated levels of testosterone. Testosterone triggers the emergence of secondary male sexual characteristics, including facial and body hair growth, larynx enlargement causing voice deepening, shoulder broadening, increased muscle mass development, and maturation of primary reproductive structures.

42. (B) Development of mammary glands
During female puberty, the ovaries increase the synthesis and secretion of oestrogen into blood circulation. Oestrogen promotes the growth and development of female secondary sexual characteristics, including adipose tissue deposition in hips and thighs, pelvic broadening, and mammary gland development. These structural changes prepare the female physical anatomy for eventual reproductive maturity and lactation.

43. (A) Diabetes
Insulin administration is prescribed to individuals suffering from diabetes mellitus. In this condition, pancreatic beta cells fail to produce sufficient insulin, leading to impaired cellular glucose uptake and elevated blood sugar levels. Exogenous insulin injections help transport circulating glucose into muscle and liver cells, reducing blood sugar and preventing severe metabolic complications associated with hyperglycemia.

44. (C) To prevent goitre
Iodine is a necessary trace element for the synthesis of thyroxine by the thyroid gland. Consuming iodised salt ensures adequate dietary iodine intake, preventing thyroid hormone deficiency. Without sufficient iodine, the thyroid gland undergoes compensatory enlargement under continuous thyroid-stimulating hormone stimulation, forming a goitre. Dietary iodization effectively prevents this thyroid swelling disorder.

45. (D) II, I, IV, III
When blood glucose levels rise after digestion, pancreatic sensor cells detect the elevation and respond by secreting insulin into the bloodstream. Circulating insulin signals peripheral tissue cells to absorb more glucose from circulation and store it as glycogen. As cells remove glucose from blood, total blood sugar concentrations decrease back to baseline normal levels.

46. (C) Chemical messengers
Biological regulation in animals involves complementary signaling mechanisms. The nervous system transmits rapid electrical impulses along specialized neuron networks for localized control. In contrast, the endocrine system uses organic chemical messengers called hormones. Synthesized by ductless glands, these chemical messengers are carried in blood circulation to

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widespread target organs, ensuring coordinated metabolic and developmental processes.

47. (B) Hormones
Animal behavior, including territorial aggression, courtship displays, and seasonal mating patterns, is heavily modulated by circulating hormones. Steroid hormones like testosterone and oestrogen act on specific limbic and hypothalamic brain regions to trigger behavioral responses. Hormonal signals integrate environmental stimuli with internal physiological states, driving adaptive animal behaviors necessary for survival and reproduction.

48. (D) Thyroid gland
Thyroid-stimulating hormone is secreted by the anterior pituitary gland to regulate thyroid gland activity and thyroxine production. Measuring TSH levels in blood clinical tests provides essential diagnostic information about thyroid performance. Elevated TSH indicates thyroid underactivity due to negative feedback signaling, whereas suppressed TSH levels reflect thyroid overactivity, making TSH a key marker for thyroid dysfunction.

49. (A) Synthetic thyroxine
Hypothyroidism occurs when the thyroid gland secretes insufficient quantities of thyroid hormones to meet metabolic demands. Patients present with reduced metabolic rate, fatigue, weight gain, and cold sensitivity. Hormone replacement therapy using synthetic thyroxine restores normal hormone concentrations in circulation, reversing hypothyroid symptoms and normalizing baseline cellular metabolism across body systems.

50. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
The pancreas is classified as a heterocrine or mixed gland because it contains two distinct functional tissue types within a single organ. Its exocrine acini secrete digestive enzymes through pancreatic ducts into the duodenum, while its endocrine islets release hormones directly into blood circulation. Performing both secretory roles explains its designation as a mixed gland.

51. (A) Pituitary gland
The pituitary gland is a pea-sized endocrine gland located in a bony depression of the sphenoid bone called the sella turcica, situated directly beneath the hypothalamus at the base of the brain. Attached to the hypothalamus via the infundibular stalk, this strategic anatomical location facilitates direct nervous and vascular control over pituitary hormone release.

52. (D) Neck region
The thyroid gland is positioned in the anterior lower neck region, situated directly in front of the trachea and just below the larynx. It consists of two lateral lobes connected across the midline by a thin tissue bridge called the thyroid isthmus. This superficial anatomical location allows physical examination and palpation of thyroid enlargement.

53. (B) On top of the kidneys
The human body contains two paired adrenal glands, also known as suprarenal glands. Anatomically, each adrenal gland sits as a cap on the superior pole of each kidney in the retroperitoneal space of the abdomen. Each gland comprises an outer cortex and inner medulla, each secreting distinct hormone classes vital for survival.

54. (C) Just below the stomach
The pancreas is an elongated retroperitoneal gland located transversely across the posterior abdominal wall, positioned directly behind and below the stomach. Its head nestles within the C-shaped curve of the duodenum, while its tail extends leftward toward the spleen. This positioning facilitates exocrine enzyme secretion into the small intestine alongside endocrine hormone release.

55. (D) Brain
The pineal gland is a tiny pinecone-shaped structure located in the midline of the brain, situated on the posterior wall of the third ventricle in the epithalamus region. Positioned deep within brain tissue, this gland receives light signal inputs originating from the retina to regulate melatonin synthesis and control internal biological rhythms.

56. (A) Sweat gland
Sweat glands are exocrine glands located in the dermal layer of the human skin. They possess tubular ducts that convey watery secretions containing salts and metabolic wastes onto the epidermal surface for thermoregulation. In contrast, pituitary, thyroid, and adrenal

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189. A distinguishing feature of the endocrine system is that its signals (hormones) can reach:
(A) Exclusively cells physically adjacent to an endocrine gland tissue
(B) Exclusively neuronal cells situated within the brain structures
(C) Exclusively mucosal cells lining the gastrointestinal tract
(D) Most cells via blood, but only specific target cells respond

190. Consider the following statements about hormonal changes during adolescence:
I. Boys begin to produce testosterone.
II. Girls begin to produce oestrogen.
III. Changes include increased height and changes in body shape.
IV. The adrenal gland becomes the primary reproductive organ.
Which of the above statement(s) is/are correct?
(A) II, III, and IV
(B) I, III, and IV
(C) I, II, and III
(D) I, II, III, and IV

191. Match the abnormal conditions in List I with the corresponding hormones involved in List II.
List I: (Abnormal Condition)
P. Hyperglycemia (High blood sugar)
Q. Exophthalmic Goitre
R. Stunted growth in children
S. Tetany (Low blood calcium)
List II: (Hormone Involved)
1. Growth Hormone
2. Insulin
3. Parathormone
4. Thyroxine
(A) P-4, Q-2, R-3, S-1
(B) P-2, Q-4, R-1, S-3
(C) P-1, Q-3, R-2, S-4
(D) P-2, Q-1, R-4, S-3

192. Which of the following is considered the most appropriate description of a feedback mechanism?
(A) A hepatic filtration process continuously removing degraded systemic hormones from circulation
(B) A neuromuscular pathway where sensory nerve fibers carry motor signals directly to skeletal muscles
(C) A physiological mechanism storing excess circulating peptide hormones inside the gallbladder sac
(D) A self-regulating system where output modifies its future production

193. Consider the following statements regarding the thymus gland:
I. It is large in infants and shrinks with age.
II. It is essential for the maturation of immune cells.
III. It regulates the body's metabolic rate.
Which of the above statement(s) is/are correct?
(A) Only I and II
(B) Only II and III
(C) Only I and III
(D) I, II, and III

194. Consider the following statements about hormones and target organs:
I. Hormones bind to specific receptors on target cells.
II. Target cells can be located far away from the endocrine gland.
III. Blood acts as the transport medium between the gland and the target organ.
IV. Target organs destroy hormones to produce energy.
Which of the above statement(s) is/are incorrect?
(A) I and II
(B) II and III
(C) IV only
(D) I and III

195. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The hypothalamus regulates the secretion of hormones from the pituitary gland.
Reason (R): Hypothalamus is a part of the brain that connects the nervous system to the endocrine system.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

196. Match the endocrine glands in List I with their associated characteristics in List II.
List I: (Endocrine Gland)
P. Adrenal
Q. Pituitary
R. Thyroid
S. Pancreas
List II: (Characteristic)
1. Master gland

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network. As blood flows through distant target organs, hormones leave blood vessels and bind to specific cellular receptors located on or within target cells.

67. (A) It is produced by the parathyroid glands
Thyroxine is synthesized and secreted by follicular cells of the thyroid gland, not the parathyroid glands. Parathyroid glands produce parathyroid hormone to regulate blood calcium levels. Thyroxine synthesis requires dietary iodine, and its primary physiological role involves regulating carbohydrate, protein, and fat metabolism. Insufficient iodine or thyroxine deficiency leads to thyroid swelling, known as goitre.

68. (D) Pituitary gland
Gonadal function and sex hormone production in testes and ovaries are regulated by tropic gonadotropins released from the anterior pituitary gland. Follicle-stimulating hormone and luteinizing hormone are transported via blood to the gonads, where they stimulate gamete maturation and trigger the synthesis of reproductive steroid hormones, including testosterone, oestrogen, and progesterone.

69. (B) Increase blood calcium levels
Parathormone is essential for maintaining serum calcium homeostasis. When circulating blood calcium concentrations decrease, the parathyroid glands release parathormone into the bloodstream. It acts by stimulating osteoclast activity to release calcium from bone matrix, increasing renal calcium reabsorption, and enhancing intestinal calcium absorption via activated vitamin D, thereby raising overall blood calcium levels.

70. (C) Gland → Hormone → Blood → Target Organ → Response
Hormonal regulation follows a sequential pathway starting with the endocrine gland, which synthesizes and releases a specific hormone. The hormone enters the bloodstream, which serves as the vascular transport medium carrying it across the body. Upon reaching the appropriate target organ, the hormone binds to specific cellular receptors, triggering a characteristic physiological response.

71. (D) Hormones
Chemical coordination in multicellular animals is accomplished through hormones secreted by ductless endocrine glands. Unlike rapid electrical nerve transmission, hormonal communication relies on circulating organic chemicals distributed via the blood. These signaling molecules bind selectively to target receptors, regulating long-term growth, development, metabolic processes, tissue differentiation, and reproductive activities across complex organ systems.

72. (A) An involuntary reaction to perceived danger
The fight-or-flight response is an automatic, involuntary physiological reaction triggered by the sympathetic nervous system and adrenal glands when an animal encounters perceived danger or stress. It rapidly alters involuntary bodily functions by increasing cardiac output, expanding airway diameter, elevating blood pressure, and diverting metabolic energy toward muscles, preparing the organism to confront or flee threats.

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73. (B) Testosterone
At the onset of male puberty, the pituitary gland releases gonadotropins that stimulate Leydig cells in the testes to produce large amounts of testosterone. Surging testosterone acts on androgen-sensitive hair follicles across the lower face and chin, converting fine vellus hair into coarse terminal hair and causing the growth of facial hair in adolescent males.

74. (B) Diabetes
Diabetes mellitus is a chronic metabolic disease resulting directly from endocrine gland dysfunction rather than infectious pathogens. It stems from an imbalance in insulin production by pancreatic beta cells or defective cellular insulin signaling. Without proper insulin activity, blood glucose levels remain abnormally high, disrupting energy metabolism and causing systemic pathological complications across organ systems.

75. (A) Only I and II
The nervous system transmits rapid electrical signals along specific pathways for localized control, whereas the endocrine system distributes chemical hormones through blood circulation to affect distant cells, producing longer-lasting effects. Statement III is incorrect because nervous responses are typically transient, while hormonal effects are generally sustained over longer periods, validating the selection of statements I and II.

When circulating blood calcium levels decline, parathyroid hormone secretion increases. It stimulates bone resorption by osteoclasts, enhances renal tubular calcium reabsorption, and indirect intestinal calcium absorption. These combined actions elevate blood calcium concentrations back to normal physiological operating levels.

134. (C) Thyroid - Growth hormone
Growth hormone is synthesized and released by the anterior pituitary gland, not the thyroid gland. The thyroid gland is responsible for secreting thyroxine, triiodothyronine, and calcitonin. The other pairings correctly associate the adrenal gland with cortisol, the pancreas with insulin, and the ovaries with oestrogen, identifying the thyroid-growth hormone pairing as incorrect.

135. (D) Stimulus → Endocrine Gland → Hormone → Target Tissue → Response
Endocrine signaling begins when an internal or external stimulus is detected by an endocrine gland. In response, the gland synthesizes and secretes a specific hormone directly into blood circulation. The hormone travels through blood vessels until it reaches responsive target tissues containing specific receptors, triggering a characteristic cellular physiological response.

136. (A) Primary gonadal organ possessing endocrine activity
The ovary serves as the primary female gonadal organ responsible for producing female gametes, or ova, during ovulation. Simultaneously, specialized cell clusters within ovarian follicles and the corpus luteum synthesize and secrete key sex hormones, including oestrogen and progesterone, into the bloodstream, demonstrating both reproductive gametogenic and endocrine functions.

137. (B) Endocrine glands secrete directly into blood, while exocrine glands release onto surfaces or cavities.
Exocrine glands possess conducting duct networks that carry secretions like sweat, mucus, or digestive enzymes onto epithelial surfaces or into internal organ cavities. Conversely, ductless endocrine glands lack duct structures and release regulatory hormones directly into surrounding tissue fluids and capillary blood, distributing them systemically to distant target organs.

138. (A) Gonadal glands (testes and ovaries)
Adolescent pubertal changes are initiated when gonadal glands—the testes in males and ovaries in females—begin secreting increased amounts of sex steroid hormones into blood circulation. Testicular testosterone drives male secondary sexual characteristics, while ovarian oestrogen and progesterone regulate female reproductive maturation and secondary physical traits, bringing about full adult physical maturity.

139. (A) Iodine
An enlarged neck swelling, accompanied by lethargy and weight changes, indicates goitre caused by iodine deficiency. Iodine is necessary for synthesizing thyroxine in the thyroid gland. Lacking iodine, thyroxine production falls, prompting excessive compensatory TSH secretion from the pituitary gland, which causes enlargement of thyroid tissue and manifests as a swollen neck.

140. (C) I and II
The anterior pituitary gland synthesizes and secretes growth hormone, which regulates tissue growth, and thyroid-stimulating hormone, which controls thyroid gland activity. Adrenaline is secreted by the adrenal medulla, while melatonin is produced by the pineal gland, confirming that growth hormone and thyroid-stimulating hormone are the pituitary hormones listed.

141. (D) Progesterone
Progesterone is a steroid hormone produced by the corpus luteum within the ovary following ovulation. It plays a crucial role in female reproduction by promoting uterine endometrial vascularization and secretory transformation, preparing the uterine lining for embryo implantation and maintaining pregnancy by suppressing uterine smooth muscle contractions during gestation.

142. (C) Dilation of bronchioles for higher oxygen intake
An abrupt release of adrenaline into circulation prepares the body for intense physical exertion during emergencies. Adrenaline acts on beta-adrenergic receptors in airway smooth muscle, causing bronchodilation. Expanding bronchiole diameters reduces airway resistance, increasing airflow volume and enhancing pulmonary gas exchange to supply extra oxygen to oxygen-demanding skeletal muscle tissues.

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by pituitary gonadotropins like LH and FSH. Statement IV is incorrect because adrenaline governs acute stress responses rather than gamete maturation, making the choice containing statements I, II, and III the correct combination regarding reproductive hormonal control.

86. (D) None of the above
Hormones like oxytocin and antidiuretic hormone are synthesized by neurosecretory neurons in the hypothalamus and transported along axons to the posterior pituitary for storage and release. Because the given options do not list oxytocin or antidiuretic hormone, selecting none of the above represents the correct response regarding hormones stored but not synthesized by pituitary tissue.

87. (D) Adrenal cortex
The adrenal gland is divided into an outer cortex and an inner medulla. Cortisol is a glucocorticoid steroid hormone synthesized and secreted specifically by the zona fasciculata region of the adrenal cortex. Its synthesis is stimulated by adrenocorticotropic hormone released from the anterior pituitary gland, regulating metabolism and stress responses across body tissues.

88. (A) Impairment of the immune response
Chronically elevated cortisol levels resulting from long-term psychological or physical stress produce systemic immunosuppressive effects. Cortisol inhibits pro-inflammatory cytokine production, reduces white blood cell proliferation, and suppresses antibody synthesis. Consequently, persistent high cortisol exposure weakens cellular immune defenses, rendering the human body increasingly susceptible to opportunistic infections, delayed wound healing, and metabolic dysfunction.

89. (B) TSH - Thyroid gland
Thyroid-stimulating hormone is a tropic glycoprotein hormone synthesized and released by the anterior pituitary gland. Its primary target organ is the thyroid gland located in the neck. Upon binding to specific receptors on thyroid follicular cells, thyroid-stimulating hormone activates enzymatic pathways that stimulate iodine uptake and drive the synthesis and release of thyroxine.

90. (B) It prevents over-secretion or under-secretion of hormones to maintain balance
Feedback mechanisms are vital for endocrine health because they continuously adjust hormone secretion rates relative to physiological requirements. By sensing hormone concentrations or metabolic products in circulating blood, feedback loops inhibit further release during excess conditions or stimulate production during deficiency. This precise regulation prevents destructive hormonal excesses or deficits, preserving internal biological homeostasis.

91. (A) Iodine
Thyroid follicles are the primary structural and functional units of the thyroid gland responsible for producing thyroid hormones. Follicular cells actively transport iodide ions from circulating blood into the follicular lumen using sodium-iodide symporters. Iodine is subsequently iodinated into tyrosine residues of thyroglobulin, forming the essential chemical foundation for synthesizing functional thyroxine molecules.

92. (C) Thymus
The thymus gland secretes thymosin hormones, which direct the development and maturation of T-lymphocytes, vital white blood cells responsible for adaptive cell-mediated immunity. Immature T-cell precursors migrate from bone marrow to the thymus, where thymosin signaling induces surface receptor differentiation, enabling mature T-lymphocytes to recognize foreign antigens and coordinate cellular immune defenses.

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93. (D) Melatonin
Melatonin secretion by the pineal gland is regulated by light-dark cycles detected through retinal pathways. Photic stimulation during daylight hours inhibits melatonin synthesis. Conversely, darkness removes light inhibition, prompting increased melatonin release into blood circulation. Elevated nocturnal melatonin levels signal nighttime conditions to the central nervous system, promoting sleepiness and synchronizing circadian rhythms.

94. (C) Hypersecretion of thyroxine
Exophthalmic goitre, or Graves' disease, is an autoimmune disorder characterized by hypersecretion of thyroxine from an overactive thyroid gland. Autoantibodies continuously stimulate thyroid follicular cells, leading to elevated metabolic rates, weight loss, rapid heart

receptor activation stimulates intracellular cyclic AMP pathways, accelerating SA node firing rates and increasing myocardial contractility. As a result, the heart contracts faster and with greater force, increasing cardiac output to pump oxygenated blood to essential organs.

153. (B) Act on specific target organs
A defining physiological feature of hormones is target specificity. Although endocrine glands secrete hormones directly into circulating blood, allowing them to reach every organ system, hormones exert biological effects exclusively on target organs possessing matching molecular receptors. Tissues lacking these complementary cell receptors remain completely unaffected by the presence of circulating hormone molecules.

154. (B) A disorder caused by endocrine imbalance
Diabetes mellitus is a non-communicable metabolic disorder caused by endocrine system imbalance. It arises either when pancreatic beta cells produce insufficient insulin or when peripheral body tissues exhibit diminished responsiveness to circulating insulin. This hormonal deficit prevents normal blood glucose regulation, leading to persistent hyperglycemia and multi-organ metabolic complications across affected human physiological systems.

155. (A) Only I and II
The thyroid gland is located in the anterior neck region and produces thyroxine, which regulates basal metabolic rate, cellular oxygen consumption, and intermediate energy metabolism. Statement III is incorrect because the pineal gland regulates sleep-wake cycles through melatonin secretion, confirming that the option containing statements I and II provides the correct facts.

156. (C) Neural detection of stress triggering adrenal hormone release
Functional integration between nervous and endocrine systems is demonstrated during acute stress response pathways. Sensory perception of stress or threat causes central nervous processing in the brain, which transmits sympathetic nerve signals down to the adrenal medulla. This neural activation prompts the endocrine adrenal medulla to release adrenaline into blood circulation, producing coordinated body-wide physiological adjustments.

157. (D) Pancreas
Evaluating fasting blood sugar levels measures baseline glycemic control maintained by pancreatic endocrine hormones. The Islets of Langerhans within the pancreas produce insulin and glucagon to balance blood glucose levels. Persistent fasting hyperglycemia reflects deficient insulin production or cellular resistance, providing doctors with crucial diagnostic data to evaluate pancreatic endocrine health and screen for diabetes.

158. (C) Growth hormone released by pituitary gland
Pituitary dwarfism is a skeletal growth disorder caused by hyposecretion of growth hormone from the anterior pituitary gland during childhood. Deficient growth hormone reduces cell proliferation and bone matrix deposition at epiphyseal growth plates. Consequently, longitudinal bone growth is severely retarded, resulting in abnormally short adult stature despite normal body proportions and cognitive mental development.

159. (B) Oestrogen
During female pubertal development, rising levels of oestrogen released by developing ovarian follicles stimulate physical maturation. Oestrogen specifically targets mammary tissue, promoting the growth and branching of lactiferous ducts, stromal tissue accumulation, and adipose deposition in breasts. These structural changes establish female secondary sexual characteristics and prepare mammary glands for eventual reproductive function.

160. (D) P-2, Q-4, R-1, S-3
Melatonin secreted by the pineal gland regulates circadian sleep-wake cycles. Thyroxine produced by the thyroid gland controls basal metabolic rate across body tissues. Insulin synthesized by pancreatic beta cells lowers blood glucose levels. Adrenaline released by the adrenal medulla prepares physiological systems for emergency stress, establishing the exact matched functional pairs.

161. (A) Pituitary gland
Thyroid-stimulating hormone, also known as thyrotropin, is synthesized and released by thyrotrope cells in the anterior lobe of the pituitary gland. Released TSH travels through blood circulation to bind specific receptors on thyroid follicular cells, stimulating iodine uptake,

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104. (A) The person develops diabetes mellitus
If feedback mechanisms regulating insulin secretion fail or cellular insulin responsiveness is impaired, glucose cannot effectively enter peripheral tissues. Consequently, blood sugar levels remain elevated, leading to persistent hyperglycemia. Uncontrolled high blood glucose over time causes diabetes mellitus, producing symptoms like excessive thirst, frequent urination, metabolic exhaustion, and severe long-term cardiovascular and renal tissue damage.

105. (B) P-2, Q-4, R-3, S-1
The pituitary gland is situated at the base of the brain. The thyroid gland resides in the anterior region of the neck. The adrenal glands are capped atop the kidneys in the retroperitoneal abdomen. The thymus gland is positioned in the upper chest cavity behind the sternum, establishing the correct geographical placement for each gland.

106. (B) Testosterone
Testosterone acts on specific androgen receptors in male brain centers, modulating social and reproductive behaviors. High circulating levels of testosterone promote territorial defence, competitive aggression, scent marking, and courtship rituals across many animal species. These behavioral adaptations enhance male competitive fitness, securing mating access and established territory protection within animal populations.

107. (A) Thymus gland
The thymus gland is large and highly active during infancy and early childhood, producing thymosin to drive T-cell immune maturation. At the onset of puberty, rising sex steroid levels initiate thymic involution, causing the gland to progressively shrink and lose functional lymphoid tissue, which is largely replaced by fat throughout adulthood.

108. (C) Thyroxine
Thyroxine, secreted by the thyroid gland, acts as the primary metabolic regulator in the human body. It dictates the basal metabolic rate by governing cellular oxygen consumption, mitochondrial activity, and ATP production. Through these pathways, thyroxine controls the speed at which tissues burn dietary carbohydrates, fats, and proteins to generate cellular energy and body heat.

109. (D) Thyroxine
Severe congenital or childhood deficiency of thyroxine results in cretinism, a clinical condition marked by profound physical growth failure and irreversible mental retardation. Because thyroxine is crucial for normal skeletal development, tissue differentiation, and central nervous system myelination, inadequate hormone levels severely impair both cognitive development and linear physical body growth in infants.

110. (C) Only I and II
The pancreas contains exocrine acini that secrete digestive enzymes through pancreatic ducts into the duodenum, and endocrine islets that release insulin and glucagon directly into blood circulation. Statement III is incorrect because exocrine glands release secretions via ducts rather than into blood, making the option identifying statements I and II the correct choice.

111. (B) Parathyroid hormone (PTH)
Parathyroid hormone is secreted by parathyroid chief cells when serum calcium concentrations drop below physiological setpoints. It acts on target organs to restore blood calcium levels by stimulating bone osteoclast resorption, increasing renal distal tubule calcium reabsorption, and promoting intestinal calcium absorption through calcitriol activation, preventing muscular tetany and preserving mineral equilibrium.

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112. (D) Hypothalamus
The hypothalamus serves as the primary integration center connecting neural inputs with endocrine outputs. Located in the brain, it processes internal sensory signals and regulates anterior pituitary gland secretions via releasing and inhibiting neurohormones. Through this hypothalamic-pituitary axis, it exercises master control over autonomic functions, metabolic equilibrium, body temperature, and systemic hormone balance.

113. (A) Slower but generally long-lasting
Nervous control relies on high-speed electrical nerve impulses along axons for immediate, brief responses. Conversely, hormonal control involves chemical messenger synthesis, vascular transportation through blood, and cellular receptor binding. This pathway results in a slower onset of physiological action, but the biological effects are generally more widespread, sustained, and long-lasting across body tissues.

rate, thyroid gland enlargement, and protrusion of the eyeballs caused by fluid accumulation in retro-orbital tissue spaces behind eyes.

95. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Including iodised salt in daily meals provides necessary iodine for synthesizing thyroxine within thyroid follicular cells. Sufficient iodine prevents thyroid hormone deficiency and avoids excessive compensatory stimulation by thyroid-stimulating hormone, which causes thyroid gland hypertrophy and goitre formation. The rationale provided directly explains why iodised salt consumption is medically recommended in diets.

96. (D) Binds specifically to cells possessing matching receptors for that hormone
Although hormones circulate indiscriminately throughout the entire vascular network, they act selectively on target cells that possess complementary molecular receptors. The specific binding of a hormone to its matching membrane or intracellular receptor triggers target-cell biological responses. Cells lacking matching receptors remain completely unaffected, establishing the physiological specificity of endocrine communication mechanisms.

97. (A) Thyroid gland
In addition to thyroxine, the thyroid gland contains specialized parafollicular cells, known as C-cells, which produce and secrete calcitonin. Calcitonin functions as an antagonist to parathyroid hormone during hypercalcemia. It lowers blood calcium concentrations by inhibiting bone resorption by osteoclasts and promoting calcium deposition into bone matrix, maintaining calcium mineral balance.

98. (C) Decreased rate of respiration
Adrenaline release during fear or alarm stimulates physiological adaptations designed to enhance oxygen and nutrient delivery to tissues. It increases breathing rate and dilates bronchioles to maximize pulmonary gas exchange rather than decreasing respiration. Elevated heart rate, pupil dilation, and increased skeletal muscle blood flow are standard physical outcomes of emergency adrenaline secretion.

99. (A) Testosterone
During male puberty, testicular Leydig cells increase testosterone secretion under pituitary stimulation. Rising testosterone levels act on laryngeal cartilages and vocal cords, causing larynx enlargement and vocal cord lengthening and thickening. These structural anatomical changes alter vocal acoustics, causing the pitch of the voice to deepen and break during male adolescent development.

100. (D) I, II, III, IV
Anatomically arranged from superior to inferior in the human body, the hypothalamus resides at the base of the brain. Immediately below it sits the pituitary gland within the skull base. Lower down in the neck region lies the thyroid gland. Finally, the paired adrenal glands are situated in the retroperitoneal abdominal cavity atop the kidneys.

101. (B) A chemical messenger secreted into the bloodstream
A hormone is an organic chemical messenger synthesized and secreted by ductless endocrine glands directly into the surrounding interstitial fluid and vascular system. Carried through blood circulation, hormones travel to distant target tissues, where they bind to specific cell receptors and regulate essential physiological processes, metabolic functions, cellular growth, and systemic development.

102. (C) Maintain a lower temperature essential for normal sperm formation
In human males, the testes are housed outside the pelvic cavity within the scrotal sac. Normal spermatogenesis requires a temperature approximately two to two and a half degrees Celsius lower than internal core body temperature. Positioning the testes externally within the scrotum maintains this optimal cooler environment necessary for proper sperm production and viability.

103. (D) Oestrogen
Female pubertal development is driven by an increase in oestrogen secretion from maturing ovarian follicles. Oestrogen promotes the emergence of female secondary sexual traits, including ductal growth in mammary glands for breast development, pelvic girdle widening for hip broadening, and subcutaneous adipose distribution, establishing adult female physical anatomical features and reproductive readiness.

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to central nervous structures, helping regulate sleep patterns, body temperature rhythms, and seasonal physiological adaptations.

124. (C) Pituitary gland
The hypothalamus produces specialized peptide releasing hormones, such as growth hormone-releasing hormone, that travel through the hypophyseal portal vessel network directly to the anterior pituitary gland. Upon reaching target pituitary endocrine cells, these releasing hormones bind specific receptors, stimulating the synthesis and secretion of corresponding pituitary tropic hormones into systemic circulation.

125. (D) I, II, and III
Hormonal disorders are diagnosed using blood tests to evaluate circulating hormone concentrations and are treated effectively using hormone replacement therapies, such as insulin injections for diabetes and synthetic thyroxine for hypothyroidism. Statement IV is incorrect because many hormonal imbalances are treatable, confirming the selection of statements I, II, and III.

126. (C) Growth hormone
Growth hormone, synthesized by the anterior pituitary gland, is essential for driving linear skeletal development and longitudinal bone growth during childhood. A severe deficiency in growth hormone production impairs cell proliferation in epiphyseal growth plates of long bones. Consequently, affected children experience significantly retarded growth velocity, resulting in pituitary dwarfism.

127. (B) Thymus
The thymus gland is a bilobed lymphatic endocrine organ situated in the superior mediastinum of the upper chest, positioned directly behind the sternum and anterior to the heart and major blood vessels. It serves as a primary site for T-lymphocyte maturation during childhood before undergoing gradual age-related atrophy following puberty.

128. (D) Because they transmit chemical signals between cell groups
Hormones are designated as chemical messengers because they convey regulatory information from endocrine cell groups to distant target tissues. Released into blood circulation, these specialized organic molecules travel across the body, binding to complementary cell receptors and transmitting chemical instructions that alter target cell metabolic activities, gene expression, and physiological behavior.

129. (A) Hyperglycemia
Hyperglycemia is the medical term for an abnormally high concentration of glucose circulating in blood plasma. In conditions involving absolute or relative insulin deficiency, such as diabetes mellitus, glucose cannot effectively enter tissue cells for storage or utilization. Consequently, unabsorbed glucose accumulates within the bloodstream, leading to persistent hyperglycemia and associated metabolic complications.

130. (C) Only II and III
Thyroxine directly regulates the basal metabolic rate of body cells, while insulin controls blood sugar concentrations by promoting glucose storage and tissue absorption. Adrenaline primarily manages emergency fight-or-flight reactions rather than standard metabolic rate or glycemic baseline control, making the combination of thyroxine and insulin the correct answer.

131. (A) The nervous system can stimulate or inhibit the release of hormones.
The nervous system and endocrine system operate synchronously to regulate internal physiological processes. Neural centers in the brain, particularly the hypothalamus, receive internal and environmental sensory information and send electrical or neurochemical signals to endocrine glands. These signals directly stimulate or inhibit hormone release, ensuring integrated homeostatic adjustments across body organs.

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132. (D) Blood vessels of skin and digestive organs
During emergency stress, adrenaline release induces selective smooth muscle contraction in arteriolar walls supplying peripheral skin and gastrointestinal organs. This vasoconstriction reduces blood flow to non-essential digestive and cutaneous tissues. Concurrently, vasodilation increases blood flow to active skeletal muscles and heart tissue, optimizing oxygen and glucose delivery during fight-or-flight states.

133. (B) Increase calcium levels in the bloodstream
The parathyroid glands secrete parathyroid hormone to maintain serum calcium balance.

76. (C) Blood glucose
Diabetes mellitus is characterized by impaired glucose clearance from systemic circulation due to insulin deficiency or insulin resistance. Diagnostic evaluation requires measuring blood glucose levels under fasting conditions or following glucose intake. Persistently elevated blood glucose concentrations above established clinical thresholds confirm impaired glycemic control and validate a formal diagnosis of diabetes mellitus in patients.

77. (D) Endocrine system
Animal organisms rely on two integrated regulatory networks to control physiological functions: the nervous system and the endocrine system. While the nervous system manages rapid, short-term responses via electrical impulses, the endocrine system provides sustained, long-term regulation using chemical hormones distributed through blood. Together, they coordinate growth, metabolism, reproduction, and internal homeostatic stability.

78. (C) Elevated metabolic rate and weight loss
Hyperthyroidism involves hypersecretion of thyroxine by an overactive thyroid gland. Elevated thyroxine accelerates the body's basal metabolic rate, causing increased cellular energy consumption and heat generation. Affected individuals exhibit symptoms such as rapid weight loss despite increased appetite, elevated heart rate, profuse sweating, nervousness, and muscle weakness resulting from excessively rapid nutrient oxidation.

79. (B) Insulin
Insulin facilitates cellular energy production by facilitating the transport of glucose from blood plasma into skeletal muscle cells, adipocytes, and other tissues. It triggers the translocation of GLUT4 glucose transporter proteins to the cell membrane, allowing glucose entry. Inside cells, glucose undergoes glycolysis and aerobic respiration to generate ATP necessary for cellular metabolic processes.

80. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Adrenaline is designated as the emergency hormone because the adrenal medulla secretes it rapidly into circulation during stressful or dangerous situations. Its systemic actions immediately increase heart rate, elevate blood pressure, expand airways, and mobilize glucose energy reserves, preparing the body for sudden physical exertion. The physiological explanation directly justifies its common emergency hormone name.

81. (A) Excessive thirst and frequent urination
In diabetes mellitus, high blood glucose levels exceed renal reabsorption capacity, causing glucose excretion in urine. This osmotic effect draws excessive water into urine, leading to frequent urination, known as polyuria. Rapid fluid loss causes severe dehydration, which triggers intense, persistent thirst, termed polydipsia. Polyuria and polydipsia are classic diagnostic symptoms of diabetes.

82. (C) Thyroid, Pituitary, Adrenal
The thyroid, pituitary, and adrenal structures are exclusively ductless endocrine glands. They synthesize specialized chemical hormones and release them directly into blood capillaries for systemic distribution. Other listed structures, such as salivary, sweat, tear, and liver glands, possess dedicated anatomical ducts for releasing exocrine fluids onto body surfaces or into digestive cavities.

83. (A) Dwarfism
An underactive anterior pituitary gland during childhood results in deficient secretion of growth hormone. Lacking adequate growth hormone, cell division, bone matrix synthesis, and long bone epiphyseal elongation are severely impaired. Consequently, the child experiences stunted linear skeletal growth, resulting in pituitary dwarfism characterized by short stature with proportional physical body features.

84. (D) Pituitary
The pituitary gland is structurally divided into two distinct anatomical regions: the anterior pituitary and the posterior pituitary. The anterior lobe synthesizes and secretes tropic hormones like growth hormone and TSH. The posterior lobe stores and releases neurohormones synthesized by hypothalamic neurons, such as oxytocin and vasopressin, establishing distinct lobar hormone secretion.

85. (B) I, II, and III
Reproductive regulation involves testicular testosterone release in males, ovarian oestrogen secretion in females, and overarching control

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143. (B) Gigantism
Severe iodine deficiency impairs thyroxine synthesis, causing goitre, hypothyroid sluggishness, delayed physical development, and congenital cretinism accompanied by mental retardation in infants. Gigantism is unrelated to iodine levels and thyroid function, as it is caused by hypersecretion of growth hormone by the anterior pituitary gland during childhood prior to epiphyseal plate fusion.

144. (D) Regulating metabolism and inflammation over extended periods
Cortisol, produced by the adrenal cortex, helps the body manage sustained stress over extended periods. It alters intermediate metabolism by promoting gluconeogenesis, mobilizing fatty acids, and modulating protein breakdown to supply steady energy. Simultaneously, cortisol suppresses inflammatory cascades and immune responses, protecting tissues from excessive inflammatory damage during chronic stress conditions.

145. (C) Assertion (A) is true but Reason (R) is false.
Hormones are effective in tiny quantities because target cell receptors produce amplified signal cascades. However, reason R is incorrect because hormones are not reusable catalysts that remain in blood permanently. After binding to target receptors and executing signaling functions, circulating hormones are degraded by hepatic enzymes or excreted by kidneys, requiring continuous fresh synthesis.

146. (C) Hypothalamus
The hypothalamus, situated at the ventral brain surface, serves as the primary neuroendocrine interface connecting the central nervous system with the endocrine network. It integrates neural sensory signals regarding internal body states and responds by synthesizing neurohormones that directly regulate pituitary gland hormone release, maintaining homeostatic equilibrium across complex bodily systems.

147. (A) Pituitary gland
Diabetes insipidus is a condition caused by deficient release or action of antidiuretic hormone, also known as vasopressin, which is stored in and released by the posterior pituitary gland. Lacking functional antidiuretic hormone, renal collecting ducts fail to reabsorb water, resulting in continuous excretion of large volumes of dilute urine and persistent thirst.

148. (D) III, II, IV, I
Arranged anatomically from superior to inferior in the body, the pineal gland is situated deepest in the brain epithalamus. Lower down in the cervical neck region lies the thyroid gland. Further down in the upper abdomen behind the stomach sits the pancreas. Finally, the paired adrenal glands sit atop the kidneys in the retroperitoneal cavity.

149. (B) Transport hormones rapidly to target tissue receptors
Because ductless endocrine glands lack localized anatomical conduits, they rely entirely on the vascular circulatory system for systemic transport. After hormones diffuse into adjacent blood capillaries, blood flow rapidly distributes these chemical messengers throughout the body network, delivering them directly to specific target tissue receptors where they initiate regulated physiological responses.

150. (C) Cortisol
Cortisol is a glucocorticoid hormone synthesized by the adrenal cortex during physical or emotional stress. When chronically elevated, cortisol exerts potent immunosuppressive effects by suppressing lymphocyte proliferation, reducing pro-inflammatory cytokine production, and blunting antibody synthesis. Consequently, persistent high cortisol exposure impairs immune system efficiency, increasing vulnerability to infectious diseases and inflammatory disorders.

151. (D) Helps cells absorb glucose to lower blood sugar
Exogenous insulin administered to a diabetic patient binds to specific insulin receptors on skeletal muscle, adipose tissue, and hepatic cell membranes. This binding triggers intracellular signaling pathways that insert glucose transporter proteins into cell membranes, facilitating rapid glucose uptake from circulating blood. Consequently, cellular glucose utilization increases and elevated blood sugar levels decrease toward normal physiological levels.

152. (A) Contracting faster to pump blood
Adrenaline released during acute stress binds specifically to beta-1 adrenergic receptors located on cardiac pacemaker and myocardial cells. This

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114. (C) Thyroid gland
The thyroid gland requires iodine as a critical chemical component to synthesize thyroxine and triiodothyronine. A severe dietary iodine deficit prevents thyroid follicular cells from producing functional thyroid hormones. As a result, blood hormone levels drop, prompting excessive pituitary TSH release, which causes thyroid tissue enlargement, clinically designated as endemic goitre.

115. (A) II, IV, I, III
When a threatening stimulus occurs, the brain interprets danger and transmits neural signals to activate the adrenal medulla. The adrenal glands secrete adrenaline directly into blood circulation. Circulating adrenaline travels via blood vessels to cardiac and respiratory target tissues, increasing heart rate, dilating airways, and preparing the body for immediate survival action.

116. (D) Glycogen
Glucagon is released by pancreatic alpha cells in response to hypoglycemia. It binds to surface receptors on hepatic liver cells, stimulating glycogenolysis—the enzymatic depolymerization of stored glycogen into glucose-1-phosphate and free glucose. This liberated glucose is transported out of hepatocytes into systemic blood circulation, raising blood glucose levels back toward normal limits.

117. (B) A ductless gland secreting hormones directly into tissue fluid and blood
An endocrine gland is an anatomically ductless secretory structure composed of specialized epithelial cells. Instead of releasing secretions into ducts, endocrine cells produce chemical signaling molecules called hormones and discharge them into surrounding interstitial fluid. These hormones diffuse rapidly into adjacent vascular capillary beds, enabling systemic blood distribution to distant target tissues.

118. (C) They are required in very minute quantities
Hormones are extremely potent chemical signaling molecules that exert profound physiological effects while present in minute nanomolar or picomolar concentrations in blood circulation. Because target cells possess high-affinity membrane or intracellular receptors, tiny amounts of circulating hormone trigger amplified biochemical signal cascades, eliminating the need for large quantities of hormone production.

119. (D) Pancreas
Persistent high blood sugar levels accompanied by glucosuria indicate pancreatic endocrine malfunction, specifically impaired insulin production or release by beta cells in the Islets of Langerhans. Deficient insulin prevents glucose uptake into tissue cells, leading to severe hyperglycemia that exceeds renal reabsorption thresholds, causing excess glucose to spill into urine.

120. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Endocrine glands rely on feedback regulation to modulate hormone release in direct response to circulating physiological conditions. Feedback loops maintain exact hormonal concentrations, preventing pathological tissue damage caused by hypersecretion or hyposecretion. The protective homeostatic role outlined in the reason provides the exact logical explanation for why feedback mechanisms control secretion parameters.

121. (B) Nervous and Endocrine systems
The fight-or-flight response requires coordinated interaction between the nervous and endocrine systems. The central nervous system detects perceived threats and transmits immediate neural signals down sympathetic pathways to the adrenal medulla. The adrenal medulla responds by secreting adrenaline into blood circulation, rapidly altering cardiac, vascular, and metabolic functions across the body.

122. (B) Acromegaly involving enlarged facial bones and extremities
Hypersecretion of growth hormone in adults, occurring after epiphyseal growth plates have fused, cannot produce vertical long bone elongation. Instead, excess growth hormone causes acromegaly, a condition marked by progressive thickening of acral bones and soft tissues. Affected adults exhibit enlargement of facial bones, jaw protrusion, and coarsened hands and feet.

123. (A) Regulating the biological clock and sleep cycle
The pineal gland functions as a key neuroendocrine regulator of circadian rhythms and internal biological clock activities. By secreting melatonin in response to environmental darkness and suppressing release during daylight, the pineal gland communicates light-dark cycles

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thyroxine synthesis, and hormone release into the bloodstream to regulate body metabolism.

162. (C) By the feedback mechanism
The body regulates hormone secretion precise quantities through negative and positive feedback mechanisms. Endocrine glands continuously monitor circulating hormone levels or physiological variables like blood glucose. When concentrations reach target limits, feedback signals inhibit further hormone production. This automated self-regulating system prevents hormonal overproduction or deficiency, maintaining stable internal physiological balance across body systems.

163. (A) Liver
The primary target organ for glucagon action is the liver. Secreted by pancreatic alpha cells in response to low blood glucose, glucagon binds to specific cell surface receptors on hepatic parenchymal cells. This binding activates glycogen phosphorylase enzymes, promoting hepatic glycogenolysis and gluconeogenesis, releasing glucose into circulating blood to elevate blood sugar levels.

164. (D) The individual's body would fail to prepare for emergency action
If the adrenal glands fail to secrete adrenaline during acute danger, the body cannot mount an effective fight-or-flight response. Lacking adrenaline signaling, cardiac acceleration, airway bronchodilation, glycogen mobilization, and skeletal muscle blood flow redirection will not occur. Without these crucial physiological adaptations, the individual cannot rapidly generate the physical energy needed to survive threats.

165. (B) Testosterone
Testosterone is a lipid-soluble steroid hormone synthesized from cholesterol precursor molecules in Leydig cells of the testes. Unlike water-soluble peptide or amine hormones like insulin and adrenaline, steroid hormones pass through cell membranes to bind intracellular androgen receptors, regulating nuclear gene transcription and directing male reproductive differentiation and secondary sexual development.

166. (C) Thyroxine
Cretinism is a severe developmental disorder caused by congenital hyposecretion of thyroxine during infancy and early childhood. Because thyroxine is essential for protein synthesis, skeletal maturation, and central nervous system myelination, its deficiency severely impairs brain development and bone growth, leaving affected children with permanent mental retardation and dwarfism if untreated.

167. (D) Insulin injections
Severe diabetes mellitus involves absolute or critical deficiency of endogenous insulin production by damaged pancreatic beta cells. Administering exogenous insulin injections replaces the missing pancreatic hormone, enabling circulating blood glucose to enter skeletal muscle and liver cells. Regular insulin therapy effectively restores glycemic control, prevents severe metabolic ketoacidosis, and manages diabetic symptoms.

168. (A) It promotes immune cell maturation to combat infections
The thymus gland functions as a vital primary lymphoid organ responsible for cell-mediated immune system development. It secretes thymosin hormones that drive the differentiation, maturation, and immunological selection of T-lymphocytes migrating from bone marrow. Fully matured T-cells exit the thymus and populate peripheral lymphoid tissues, enabling the immune system to recognize and eliminate pathogens.

169. (B) Thyroid - Goitre
Goitre is a clinical condition characterized by abnormal enlargement of the thyroid gland, caused by iodine deficiency or thyroid hormone synthesis disorders. Compensatory TSH secretion causes thyroid tissue hypertrophy. Other listed options incorrectly pair the pancreas with goitre, the pituitary gland with diabetes mellitus, and the adrenal gland with pituitary dwarfism, making thyroid-goitre correct.

170. (B) Low blood sugar → Pancreas secretes glucagon → Liver releases glucose → Blood sugar rises
When blood glucose drops below normal setpoints, pancreatic alpha cells detect hypoglycemia and secrete glucagon into the bloodstream. Glucagon travels via blood vessels to the liver, where it stimulates hepatic glycogenolysis, breaking down stored glycogen into free glucose. Released glucose enters systemic circulation, elevating

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However, biological responses occur exclusively in specific target cells equipped with matching molecular receptors. Cells lacking corresponding receptors ignore the circulating hormone, ensuring precise target-specific physiological regulation.

190. (C) I, II, and III
Adolescence is marked by increased production of testicular testosterone in males and ovarian oestrogen in females, driving secondary sexual development, growth spurts, and altered body contours. Statement IV is incorrect because gonads, not adrenal glands, serve as primary reproductive organs, confirming that the combination of statements I, II, and III is correct.

191. (B) P-2, Q-4, R-1, S-3
Hyperglycemia is caused by deficient insulin function. Exophthalmic goitre arises from hypersecretion of thyroxine. Stunted growth in children results from deficient growth hormone secretion during growth periods. Tetany involves hypocalcemic muscle spasms caused by insufficient parathormone, establishing the correct matching relationships between clinical abnormal conditions and their associated hormones.

192. (D) A self-regulating system where output modifies its future production
A feedback mechanism is a self-regulating physiological control system in which the output or result of a process loops back to modify future production rates. In endocrine signaling, rising hormone concentrations or metabolic products suppress or stimulate further gland secretion, allowing the body to maintain constant internal homeostatic balance amidst changing conditions.

193. (A) Only I and II
The thymus gland is prominent in infants and undergoes gradual age-related atrophy following puberty. It secretes thymosin, which is essential for T-lymphocyte maturation and immune competence. Statement III is incorrect because the thyroid gland, rather than the thymus, regulates basal metabolic rate, confirming that statements I and II represent the correct facts.

194. (C) IV only
Hormones bind to specific receptors on distant target cells via vascular blood transport to regulate cellular functions. Statement IV is incorrect because target organs do not destroy hormones for cellular energy production; instead, circulating hormones are inactivated and metabolized primarily by the liver and kidneys, identifying statement IV as the incorrect choice.

195. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
The hypothalamus controls pituitary gland hormone release by synthesizing releasing and inhibiting neurohormones transmitted through portal blood vessels. Because the hypothalamus serves as the anatomical neuroendocrine bridge integrating nervous inputs with endocrine responses, statement R directly provides the underlying physiological explanation for how and why the hypothalamus regulates pituitary secretion.

196. (D) P-4, Q-1, R-2, S-3
The adrenal gland is the emergency gland releasing fight-or-flight adrenaline. The pituitary gland is the master gland controlling other endocrine tissues. The thyroid gland requires iodine for thyroxine synthesis. The pancreas is a mixed gland performing dual exocrine and endocrine functions, confirming the matching order between glands and characteristics.

197. (D) Assertion (A) is false but Reason (R) is true.
Assertion A is false because adrenaline decreases blood flow to the digestive system during acute stress by constricting visceral blood vessels, diverting blood to skeletal muscles. Reason R is true because digestive processing demands substantial cellular energy, which the body conserves during emergency fight-or-flight situations by temporarily suppressing non-essential gastrointestinal activity.

198. (C) IV, II, III, I
Male pubertal development begins when the hypothalamus signals the pituitary gland by secreting GnRH. The pituitary responds by releasing gonadotropic hormones into blood circulation. These hormones stimulate testicular Leydig cells to secrete testosterone, which subsequently triggers the expression of secondary male sexual characteristics, including facial hair growth and voice deepening.

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180. (D) Only I and III
Adrenaline is secreted by the adrenal medulla during acute stress, increasing breathing rate and cardiac output to supply oxygen to skeletal muscles. Statement II is incorrect because adrenaline decreases gastrointestinal blood supply through vasoconstriction, re-routing blood flow toward active skeletal muscles, confirming that statements I and III represent the correct physiological facts.

181. (B) Adrenaline
When encountering a threat, neural perception activates the dog's sympathetic nervous system, prompting the adrenal medulla to release a rapid surge of adrenaline into circulation. Adrenaline elevates heart rate, expands airways, sharpens mental focus, and diverts energy resources toward skeletal muscles, driving aggressive physical barking and preparing the animal for defensive action.

182. (C) Release into blood → Binding to specific receptor on target cell → Cellular response
Hormonal action follows a precise sequence beginning with hormone release from ductless endocrine cells directly into circulating blood. The hormone travels through blood vessels across the body until it binds to specific complementary receptors on or inside responsive target cells. Receptor activation initiates intracellular secondary messenger cascades, ultimately producing a biological response.

183. (D) Blood calcium
Accidental surgical removal of the parathyroid glands abolishes parathyroid hormone production, leading to hypocalcemia, an acute drop in blood calcium levels. Calcium ions stabilize neuronal cell membranes; without adequate circulating calcium, peripheral nerves become hyperexcitable, causing involuntary, painful skeletal muscle contractions and tetany, requiring immediate medical calcium restoration therapy.

184. (A) Direct nerve signals to the adrenal medulla
When visual pathways detect a threat like a snake, cerebral and limbic brain centers process danger and activate sympathetic nervous outflow. Sympathetic preganglionic nerve fibers send rapid electrical signals directly to the adrenal medulla. This direct neural innervation triggers immediate exocytosis of adrenaline into blood circulation, preparing the body for fight-or-flight action.

185. (B) II, III, IV, I
Following a meal, elevated blood glucose levels pass through pancreatic capillaries, where beta sensor cells detect hyperglycemia. In response, pancreatic beta cells secrete insulin into the bloodstream. Circulating insulin signals target muscle and liver tissue cells to absorb glucose, lowering blood sugar concentrations back to resting homeostatic limits via negative feedback.

186. (B) Thyroxine
Amphibian metamorphosis requires thyroxine synthesized by the tadpole's thyroid gland using dissolved environmental iodine. Thyroxine triggers gene expression programs that coordinate morphogenetic changes, including limb growth, tail resorption, lung development, and digestive tract restructuring. Without sufficient water iodine or thyroxine synthesis, tadpoles fail to metamorphose and remain trapped in aquatic larval forms.

187. (A) The endocrine network coordinates internal bodily balance
The endocrine system functions as a major regulatory network, utilizing chemical hormones transported via blood to coordinate cellular processes across organ systems. Operating in partnership with the nervous system, endocrine glands continuously adjust metabolic rates, growth, water balance, and mineral levels, maintaining homeostatic internal stability essential for animal survival and health.

188. (C) Assertion (A) is true but Reason (R) is false.
Diabetic patients receive insulin injections because deficient endogenous insulin prevents proper blood glucose regulation. However, reason R is completely false because insulin lowers blood sugar levels by promoting cellular glucose absorption and glycogen storage, rather than increasing blood sugar. Glucagon, not insulin, increases blood sugar levels during hypoglycemia to supply energy.

189. (D) Most cells via blood, but only specific target cells respond
Ductless endocrine glands release hormones directly into circulating blood, allowing these chemical signaling molecules to circulate universally across all body tissue capillary beds.

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CHAPTER 09

Reproduction in Single Organisms

1. What is the fundamental biological process responsible for maintaining the continuity of a species over generations?
(A) Respiration
(B) Nutrition
(C) Excretion
(D) Reproduction

2. Which of the following best defines asexual reproduction?
(A) Production of new offspring involving the fusion of gametes
(B) Production of offspring by two parents of the same sex
(C) Production of new offspring from a single parent without gamete fusion
(D) Production of offspring requiring fertilisation in an external medium

3. In which type of cell division do unicellular organisms generally split to form two new individuals?
(A) Meiosis
(B) Mitosis
(C) Reduction division
(D) Gametogenesis

4. Which of the following organisms primarily reproduces through binary fission?
(A) Hydra
(B) Rhizopus
(C) Spirogyra
(D) Amoeba

5. In Amoeba, the splitting of the two cells during binary fission can take place in:
(A) Any plane
(B) Only a longitudinal plane
(C) Only a transverse plane
(D) Only an oblique plane

6. Leishmania, which causes kala-azar, has a whip-like structure at one end. Binary fission in this organism occurs in which specific orientation?
(A) Transverse plane
(B) Any random orientation
(C) Longitudinal plane
(D) Equatorial plane

7. Multiple fission is a process where a single parent cell divides into many daughter cells simultaneously. Which of the following organisms reproduces by multiple fission?
(A) Plasmodium
(B) Planaria
(C) Leishmania
(D) Yeast

8. What is the initial step of binary fission in a fully grown Amoeba?
(A) Division of the cytoplasm
(B) Formation of a bud
(C) Formation of a cyst
(D) Division of the nucleus

9. Which of the following represents an outgrowth from the parent body that develops into a new individual?
(A) Cyst
(B) Bud
(C) Spore
(D) Fragment

10. Consider the following statements regarding binary fission:
I. It requires the involvement of two parent cells.
II. The parent cell divides into two equal daughter cells.
III. It is a common method of reproduction in bacteria.
Which of the above statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

11. Which simple multicellular organism uses regenerating cells to reproduce through the process of budding?
(A) Plasmodium
(B) Amoeba
(C) Spirogyra
(D) Hydra

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199. (D) The person's sleep-wake cycle would be severely disrupted
The pineal gland synthesizes and secretes melatonin in response to darkness, governing the central nervous system's internal circadian rhythms. Dysfunction of the pineal gland impairs nocturnal melatonin production, depriving the brain of light-dark temporal signals. Consequently, the individual experiences severe disruption of sleep-wake cycles, leading to persistent insomnia and circadian rhythm disorders.

200. (A) The body responds to emergencies while maintaining stability
The integrated functioning of nervous and endocrine systems allows animals to adapt dynamically to environmental threats while maintaining internal homeostatic stability. Rapid neural signaling enables immediate reactions during acute physical emergencies, whereas sustained hormonal signaling regulates ongoing metabolic pathways, growth, fluid balance, and tissue repairs, ensuring biological survival and long-term systemic equilibrium.

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(C) They consistently produce thousands of microscopic airborne spores per single individual.
(D) They constantly and uninterruptedly undergo complex sexual conjugation processes.

44. What happens to the reproduction rate of single organisms when environmental conditions become highly unfavourable (e.g., extreme heat or lack of food)?
(A) The rate decreases, and protective structures like cysts may form.
(B) The overall reproduction rate dramatically increases to guarantee species survival.
(C) The reproduction rate remains precisely identical to that observed under optimal conditions.
(D) The single-celled organisms switch completely and permanently to vegetative propagation.

45. Which of the following cell structures must duplicate before a unicellular organism can successfully divide into two viable cells?
(A) Contractile vacuole system
(B) Flagella
(C) Food vacuole
(D) Nucleus (or nucleoid)

46. In the process of budding in yeast, the nucleus of the parent cell divides. Does the entire parent cell divide into two equal halves?
(A) Yes, just like in binary fission.
(B) No, the cytoplasm divides unequally, forming a smaller bud.
(C) No, the entire parent nucleus migrates into the bud leaving the parent empty.
(D) Yes, but the new cells fuse back together immediately.

47. Which specific form of energy is fundamentally required to drive the biochemical reactions of reproduction, including DNA replication?
(A) ATP (Adenosine Triphosphate)
(B) Solar light energy absorbed by pigments
(C) Thermal heat energy from metabolic processes
(D) Mechanical kinetic energy of cytoplasm

48. What is a key advantage of the offspring being genetically similar to the parent in a stable environment?
(A) They will definitely survive any unexpected, severe viral or bacterial disease outbreak.
(B) They possess a significantly higher baseline rate of beneficial genetic mutation.
(C) They can effortlessly and rapidly switch over to complex sexual reproduction methods.
(D) They are adapted to thrive in those specific stable conditions.

49. Which of the following is NOT an environmental factor that directly affects the rate of asexual reproduction in microorganisms?
(A) Temperature
(B) Availability of environmental moisture
(C) Nutrient availability
(D) Colour of the surroundings

50. Consider the following statements regarding the necessity of DNA replication:
I. It ensures the continuity of genetic traits to the next generation.
II. It allows the new cells to synthesize necessary proteins to function.
III. It guarantees that the offspring are entirely different from the parent.
Which of the above statements is/are correct?
(A) I only
(B) I and II only
(C) II and III only
(D) I, II and III

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51. In agriculture, vegetative propagation is heavily utilised for which of the following crops?
(A) Cereal crops such as Wheat and Maize
(B) Rice and Mustard
(C) Beans and Peas
(D) Sugarcane, Rose, and Grapes

52. Why is vegetative propagation particularly beneficial for plants grown for agriculture or horticulture?
(A) All plants raised vegetatively are substantially more susceptible to fungal and viral diseases.
(B) Vegetatively raised plants bear flowers and fruits earlier than seed-grown ones.
(C) It reliably produces a novel mix of desirable traits derived from two different plant species.
(D) It requires significantly less water input and virtually no soil medium for field cultivation.

53. The genetically identical individuals produced by asexual reproduction are technically called:
(A) Hybrids
(B) Mutants
(C) Zygotes

12. In Hydra, what causes the formation of an outgrowth that eventually develops into a bud?
(A) Fusion of male and female gametes
(B) Fragmentation of the body into multiple pieces
(C) Repeated cell division at one specific site
(D) Formation of a protective cyst

13. Which unicellular fungus commonly reproduces by budding under favourable nutritional conditions?
(A) Rhizopus
(B) Penicillium
(C) Yeast
(D) Mucor

14. What happens to the tiny individuals formed through budding in Hydra once they fully mature?
(A) They remain permanently attached to the parent cell to form a large colony.
(B) They regress and gradually fuse back into the tissues of the parent body.
(C) They produce microscopic spores that disperse widely in the surrounding water.
(D) They detach from the parent body and become independent individuals.

15. Match the organisms in List I with their asexual reproduction methods in List II:
List I: Organisms
P. Amoeba
Q. Plasmodium
R. Hydra
S. Planaria
List II: Reproduction Methods
1. Multiple fission
2. Regeneration
3. Budding
4. Binary fission
(A) P-4, Q-1, R-3, S-2
(B) P-4, Q-3, R-1, S-2
(C) P-1, Q-4, R-3, S-2
(D) P-4, Q-1, R-2, S-3

16. Planaria possesses a remarkable ability to reconstruct a complete organism from a cut body piece. This process is known as:
(A) Budding
(B) Regeneration
(C) Multiple fission
(D) Spore formation

17. Regeneration is carried out by specialised cells that proliferate and make large numbers of cells. Which of the following statements about regeneration is incorrect?
(A) It is common in Planaria.
(B) Changes in cell types take place in an organised sequence during regeneration.
(C) It can occur if the organism is cut or broken up into many pieces.
(D) It is a type of sexual reproduction.

18. Why is regeneration not considered the primary mode of reproduction for most organisms?
(A) Because it requires two parents.
(B) Because most organisms cannot normally wait to be cut up to reproduce.
(C) Because it only happens in unicellular organisms.
(D) Because it produces offspring that are genetically entirely different.

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19. Spirogyra simply breaks up into smaller pieces upon maturation. These pieces grow into new individuals. What is this process called?
(A) Regeneration
(B) Binary fission
(C) Budding
(D) Fragmentation

20. Why cannot all multicellular organisms divide cell by cell to reproduce through simple fragmentation?
(A) Because their specialized reproductive organs are completely absent in simple forms.
(B) Because their cells are organised into specialized tissues and organs.
(C) Because all complex multicellular organisms are restricted to sexual reproduction.
(D) Because their cellular DNA cannot undergo replication during simple cell division.

21. In Rhizopus, the thread-like structures that develop on bread are not the reproductive parts. What are these structures called?
(A) Hyphae
(B) Sporangia
(C) Buds
(D) Roots

22. What are the tiny, blob-on-a-stick structures in Rhizopus that contain the reproductive cells?
(A) Cysts
(B) Buds
(C) Nodes

blood sugar back to physiological levels via negative feedback control.

171. (A) Insulin
Consuming sugar-rich sweets leads to rapid intestinal absorption of glucose, causing a swift postprandial rise in blood glucose concentration. Pancreatic beta cells detect this elevated circulating sugar and respond immediately by secreting insulin into the bloodstream. Insulin promotes cellular glucose uptake and hepatic glycogen synthesis, restoring blood sugar levels to normal physiological limits.

172. (C) Initiating puberty and reproductive organ maturation
Reproductive regulation depends on coordinated hormonal activity driven by the hypothalamic-pituitary-gonadal axis. During adolescence, gonadotropin-releasing hormone stimulates pituitary release of LH and FSH, which prompt gonads to secrete testosterone, oestrogen, and progesterone. These reproductive steroid hormones initiate puberty, drive secondary sexual development, promote gametogenesis, and regulate cyclic reproductive processes throughout adult life.

173. (D) Thyroxine
Amphibian metamorphosis, such as the developmental transformation of an aquatic tadpole into a terrestrial adult frog, is critically regulated by thyroxine secreted by the thyroid gland. Thyroxine triggers gene expression changes that induce tail resorption, limb development, gill regression, lung formation, and behavioral shifts needed for terrestrial adaptation during amphibian life cycles.

174. (C) The individual will grow exceptionally tall, resulting in gigantism
An overactive anterior pituitary gland during childhood causes hypersecretion of growth hormone prior to epiphyseal plate fusion in long bones. Excessive growth hormone stimulates exaggerated chondrocyte proliferation and bone matrix formation, causing extreme linear lengthening of skeletal bones. Consequently, affected individuals experience accelerated vertical growth and attain exceptional height, leading to gigantism.

175. (B) I and III
Endocrine glands are ductless glands that secrete hormones directly into the bloodstream, whereas exocrine glands, such as sweat and salivary glands, use specialized ducts to transport secretions onto surfaces. Statements II and IV are incorrect because exocrine glands do not secrete hormones into blood, validating the selection of statements I and III as correct.

176. (D) Adrenaline
Adrenaline is synthesized and secreted by the adrenal medulla, located atop the kidneys, rather than the pituitary gland. The anterior lobe of the pituitary gland synthesizes and releases growth hormone, thyroid-stimulating hormone, prolactin, and gonadotropins, making adrenaline the correct choice as a non-pituitary hormone among the listed options.

177. (A) Positive and negative feedback mechanisms
Homeostasis represents the dynamic maintenance of stable internal physiological conditions within narrow operational limits. The endocrine system regulates homeostasis primarily through negative and positive feedback mechanisms. By continuously monitoring physiological variables like blood glucose or calcium and adjusting hormone release rates accordingly, feedback loops prevent dangerous environmental fluctuations and maintain internal stability.

178. (C) It drives development of male reproductive organs and secondary traits.
Testosterone, synthesized by testicular Leydig cells, is the primary androgenic hormone in human males. During fetal development, it directs internal male genital duct formation. At puberty, rising testosterone levels drive the enlargement of primary male reproductive organs, stimulate facial and body hair growth, deepen the voice, increase muscle mass, and maintain ongoing adult spermatogenesis.

179. (A) Progesterone
Progesterone is a steroid sex hormone synthesized primarily by the corpus luteum in the ovary following ovulation. It acts on the uterine endometrium during the luteal phase of the menstrual cycle, inducing glandular secretion, tissue thickening, and increased blood vessel growth, creating an optimal uterine lining to nourish a potentially implanted embryo.

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vulnerability to environmental changes.
(D) It is an exclusive reproductive strategy that can only occur in multicellular organisms.

33. The basic event in reproduction is the creation of a copy of the cellular blueprint. This process is known as:
(A) Protein synthesis
(B) DNA replication
(C) Glycolysis
(D) Cellular respiration

34. Where is the DNA originally found in a typical eukaryotic cell prior to division?
(A) Inside the mitochondria
(B) Inside the nucleus
(C) Floating freely in the cytoplasm
(D) Attached to the cell membrane

35. DNA copying is accompanied by the creation of an additional cellular apparatus. Why is this necessary?
(A) Because DNA copying alone cannot sustain life without cell structure.
(B) Because the protective cell wall needs to be completely broken down prior to division.
(C) To produce specialized haploid gametes required for sexual fertilisation processes.
(D) To effectively reduce the total number of chromosomes in daughter cells by half.

36. Which process ensures that the two separating cells during reproduction each receive a copy of the DNA?
(A) Meiosis
(B) Conjugation
(C) Plasmolysis
(D) Mitosis

37. Are the two DNA copies generated during reproduction absolutely identical?
(A) Yes, they are always 100% structurally identical with zero genetic variations occurring.
(B) No, unreliable biochemical copying processes produce minor variations.
(C) No, they routinely differ from each other by containing exactly half of the parent's genetic material.
(D) Yes, they are completely identical unless the parent cell is actively undergoing sexual reproduction.

38. The minor inaccuracies in DNA copying during asexual reproduction lead to:
(A) A limited amount of genetic variation
(B) The immediate death of the offspring
(C) The production of gametes
(D) An entirely new species in one generation

39. What distinguishes reproduction from the general process of growth in a living organism?
(A) Growth continuously creates new individuals, while reproduction only increases cell size.
(B) Growth strictly requires nuclear DNA replication, whereas cellular reproduction does not.
(C) Growth is a phenomenon that occurs exclusively within unicellular microscopic organisms.
(D) Growth increases mass or size; reproduction creates new offspring.

40. Which of the following represents the correct sequence of events during binary fission in Amoeba?
(A) Cytokinesis → Karyokinesis → Cell growth
(B) Cell growth → Cytokinesis → Karyokinesis
(C) Cell growth → Karyokinesis → Cytokinesis
(D) Karyokinesis → Cell growth → Cytokinesis

41. In an ecosystem, what is the primary role of rapid asexual reproduction in unicellular organisms like bacteria and algae?
(A) To colonise favourable habitats rapidly and form food web bases.
(B) To rapidly decrease the organic nutrient load available within aquatic ecosystems.
(C) To spontaneously create completely new biological species through high mutation rates.
(D) To continuously absorb massive amounts of excess oxygen gas from the atmosphere.

42. Some unicellular organisms like Paramecium occasionally exchange genetic material through a process resembling sexual reproduction. What is this process called?
(A) Budding
(B) Multiple fission
(C) Sporulation
(D) Conjugation

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43. Why do bacterial populations grow exponentially under ideal conditions?
(A) They possess unusually long generation times that allow cell numbers to accumulate.
(B) They undergo rapid binary fission without needing mate selection.

(D) Sporangia

23. What do sporangia contain that eventually develop into new Rhizopus individuals?
(A) Gametes
(B) Seeds
(C) Spores
(D) Zygotes

24. Spores are covered by thick walls. What is the primary function of this thick wall?
(A) To protect the spore until it reaches a suitable moist surface to grow
(B) To prevent the spore from dividing prematurely before reaching biological maturity
(C) To attract airborne insects and small vectors for mechanical spore dispersal
(D) To store nutrient reserves such as starch and proteins required for photosynthesis

25. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Yeast cells reproduce rapidly when placed in a sugar solution.
Reason (R): Sugar provides the necessary energy (ATP) for the cellular activities involved in reproduction.
Which of the following options is correct?
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

26. Which of the following is a method of producing new plants from vegetative parts like roots, stems, and leaves?
(A) Sexual reproduction in flowering plants
(B) Spore formation
(C) Multiple fission
(D) Vegetative propagation

27. Bryophyllum can reproduce vegetatively through buds that are produced on which part of the plant?
(A) Vegetative roots
(B) Modified stems
(C) Floral structures
(D) Leaf margins

28. Which of the following is an advantage of vegetative propagation in plants?
(A) It enables seedless plants that lost seed capacity to reproduce.
(B) It introduces significant genetic variation and novel traits in offspring.
(C) It strictly requires both functional male and female parent plants to be present.
(D) It occurs at an extremely slow rate when compared directly to seed production.

29. Paramecium is a unicellular organism that typically reproduces asexually by which of the following methods?
(A) Endogenous budding mechanism
(B) Aerial spore formation
(C) Transverse binary fission
(D) Simple filament fragmentation

30. Consider the following statements regarding reproduction in bacteria:
I. Bacteria primarily reproduce through binary fission.
II. Under favourable conditions, bacterial division leads to a rapid increase in population.
III. Bacterial binary fission involves the formation of spindle fibres and a distinct nucleus.
IV. The process requires duplication of genetic material.
Which of the above statements are correct?
(A) I, II, and IV
(B) I, II, and III
(C) II, III, and IV
(D) I, III, and IV

31. What is the significant difference between the offspring produced by asexual reproduction and those produced by sexual reproduction?
(A) Offspring of asexual reproduction exhibit high genetic diversity.
(B) Offspring of asexual reproduction possess half the chromosomes of the parent.
(C) Offspring of asexual reproduction always have a shorter lifespan.
(D) Offspring of asexual reproduction are essentially identical to the parent.

32. Which of the following represents a major limitation of asexual reproduction?
(A) It demands an excessively large expenditure of metabolic energy to find a suitable mate.
(B) It invariably results in an extremely slow overall rate of population growth over time.
(C) It limits genetic diversity, increasing

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(D) Clones

54. The process of mitosis contributes to reproduction in unicellular organisms. What is the fundamental outcome of mitosis?
(A) Maintaining chromosome numbers in daughter cells.
(B) Reducing the overall cellular chromosome number by exactly half.
(C) Simultaneously producing four genetically distinct daughter cells.
(D) Fusing two haploid cell nuclei together into a single diploid cell.

55. Match the reproduction features in List I with the correct organisms in List II:
List I: Reproduction Features
P. Transverse division plane
Q. Longitudinal division plane
R. Rapid binary fission without organized nucleus
S. Cyst formation under stress
List II: Organisms
1. Bacteria
2. Paramecium
3. Plasmodium
4. Leishmania
(A) P-2, Q-4, R-1, S-3
(B) P-4, Q-2, R-1, S-3
(C) P-2, Q-1, R-4, S-3
(D) P-3, Q-4, R-1, S-2

56. Which unicellular organism exhibits a definite shape and undergoes binary fission in a specific orientation relative to its structural features?
(A) Amoeba
(B) Yeast
(C) Rhizopus stolonifer
(D) Leishmania

57. Which process is essential for the basic event of reproduction, which involves the creation of a DNA copy?
(A) Mechanical breakdown of cell walls
(B) Photosynthesis
(C) Transpiration
(D) Biochemical reactions

58. The ability of a cell to divide into several cells during multiple fission is a survival strategy. Which disease is caused by the organism (Plasmodium) that uses this method?
(A) Kala-azar
(B) Malaria
(C) Typhoid
(D) Cholera

59. When observing a permanent slide of Amoeba under a microscope, what key feature indicates it is undergoing binary fission?
(A) Presence of multiple small spores inside a heavy protective cyst wall
(B) A long whip-like flagellum dividing
(C) Small buds attached to the parent cell
(D) An elongated nucleus and a constriction in the cytoplasm

60. How does the rate of reproduction affect population growth?
(A) Higher reproduction rates drive rapid growth in favourable conditions.
(B) Higher reproduction rates directly cause a severe decrease in overall population size.
(C) Fluctuations in reproduction rates have absolutely no measurable effect on population growth.
(D) Uncontrolled rapid reproduction always leads directly to immediate ecological extinction.

61. What is the primary difference in the role of mitosis between unicellular and multicellular organisms?
(A) In single-celled unicellular organisms, mitosis causes cell growth; in complex multicellular organisms, it causes reproduction.
(B) In unicellular forms it is reproduction; in multicellular forms it is growth and repair.
(C) Mitosis is an exclusive nuclear process that takes place only within complex multicellular eukaryotic organisms.
(D) Mitosis functions primarily to generate haploid reproductive gametes in both unicellular and multicellular species.

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62. Which organelle must divide alongside the nucleus to ensure the survival of the new cell after binary fission?
(A) Only the individual mitochondria within the cell
(B) Only the cell wall
(C) Only the ribosomes
(D) The entire cytoplasm and its contained organelles

63. What structural feature is characteristic of the reproductive phase of Rhizopus?
(A) Sporangia at the tips of hyphae
(B) Green leaves

considered a form of sexual reproduction.
Reason (R): It does not involve the formation and fusion of gametes.
Which of the following options is correct?
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

106. In single-celled organisms, the entire surface of the cell is in direct contact with the environment. How does this affect reproduction?
(A) It allows easy nutrient absorption needed for energy during division.
(B) It completely prevents the single cell from undergoing any successful reproductive division.
(C) It renders the single-celled organism strictly dependent on neighboring cells for reproduction.
(D) It necessitates the evolutionary development of complex, specialized internal reproductive organs.

107. Which of the following defines the period between two consecutive cell divisions in a rapidly dividing bacterial population?
(A) Gestation period
(B) Incubation period
(C) Lifespan
(D) Generation time

108. The creation of a DNA copy mechanism is an essential part of:
(A) Transpiration
(B) Plant photosynthesis processes
(C) Cellular reproduction
(D) Digestion

109. Which feature allows spores of Rhizopus to remain viable in the air for long periods?
(A) Presence of locomotive flagella
(B) Thick protective walls
(C) High water content
(D) Large size

110. Consider the following statements about cell division in unicellular organisms:
I. Mitosis is the primary mechanism of division.
II. It leads to the creation of new individuals.
III. It involves the separation of copied DNA.
IV. It always requires a host cell to proceed.
Which of the above statements are correct?
(A) I, II and IV
(B) I, II and III
(C) II, III and IV
(D) I and IV only

111. Which method is most effective for rapidly increasing the population of a specific beneficial yeast strain in a laboratory?
(A) Continuously exposing the culture to extremely dry, freezing cold conditions to force spore formation.
(B) Providing a warm, nutrient sugar solution to promote budding.
(C) Waiting patiently for complex sexual conjugation processes to take place completely naturally in the petri dish.
(D) Mechanically cutting the microscopic yeast cells physically with micro-blades to induce fragmentation.

112. Why is the reproduction rate directly related to population growth?
(A) Because the biological process of reproduction steadily decreases the total number of individuals.
(B) Reproduction is the primary process adding new members to a population.
(C) Because successful reproduction primarily functions to increase the physical size of existing individuals.
(D) Because completing reproduction causes individual parent organisms to live indefinitely and never die.

113. In which aspect is fragmentation similar to regeneration?
(A) Both processes strictly require the pre-formation and fusion of haploid gametes.
(B) Both grow a complete organism from a separated part.
(C) Both processes occur exclusively within single-celled microscopic organisms.
(D) Both processes depend entirely on successful flowering and seed formation.

114. What limits the effectiveness of asexual reproduction in adapting to a rapidly changing ecosystem?
(A) The speed of reproduction is too slow.
(B) The lack of genetic diversity.
(C) The necessity to find a mate.
(D) The high energy cost of meiosis.

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74. If the environment changes drastically, a population of asexually reproducing organisms is at a high risk of extinction. Why?
(A) Low genetic variation means no traits may suit the new environment.
(B) They reproduce at such an excessively rapid speed that local food resources are exhausted instantly.
(C) The fundamental biochemical DNA copying mechanism completely stops functioning in altered conditions.
(D) They automatically switch over to complex sexual reproduction processes which take far too long to complete.

75. A basic requirement for both sexual and asexual reproduction at the cellular level is:
(A) Meiosis
(B) Formation of a zygote
(C) DNA replication
(D) Formation of gametes

76. In plants like Bryophyllum, the buds that take part in vegetative propagation are also known as:
(A) Floral buds
(B) Adventitious buds
(C) Apical buds
(D) Lateral axillary buds

77. Which method of reproduction allows a plant grower to propagate seedless varieties of plants like bananas and oranges?
(A) Seed germination
(B) Spore formation
(C) Sexual cross-pollination
(D) Vegetative propagation

78. Which of the following statements about fragmentation in Spirogyra is correct?
(A) It strictly requires the pre-formation and fusion of specialized male and female gametes.
(B) Upon reaching maturity, the organism simply breaks into pieces.
(C) It involves highly intricate patterns of tissue differentiation across all cellular layers.
(D) It happens exclusively when environmental water dries up completely under extreme drought.

79. What happens during multiple fission in Plasmodium?
(A) The mature vegetative cell divides symmetrically to yield two large, equal daughter cells.
(B) Small specialized buds continuously form on the external surface of the thick cyst wall.
(C) The parent genetic material is entirely degraded and re-synthesized to build a new individual.
(D) Inside a cyst, the nucleus divides repeatedly to form many small cells.

80. Arrange the following levels of biological organization related to the reproduction of a single-celled organism in the correct order, from smallest to largest:
I. Whole Organism
II. DNA molecule
III. Nucleus
IV. Cell
(A) II, III, IV, I
(B) IV, III, II, I
(C) III, II, I, IV
(D) II, IV, III, I

81. In asexual reproduction, if a parent organism has 10 chromosomes in its normal cell, how many chromosomes will the newly formed daughter cell have?
(A) 5
(B) 10
(C) 20
(D) 15

82. Which of the following is the most direct consequence of a failure in the DNA replication process prior to cellular division?
(A) The damaged cell will immediately switch its operational mode to complex sexual reproduction.
(B) The new cell lacks necessary genetic instructions to survive and function.
(C) The affected organism will compensate by growing to twice its normal physiological cell size.
(D) The cell cycle will accelerate, causing the cell to divide twice as fast as normal.

83. The process of vegetative propagation in plants relies on which cellular process?
(A) Meiosis
(B) Fertilisation
(C) Mitosis
(D) Conjugation

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Reason (R): Vegetative propagation skips the lengthy process of seed germination and early seedling growth.
Which of the following options is correct?
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

146. Which part of the Bryophyllum plant is known to drop on the soil and develop into new plants?
(A) Flowers
(B) Leaves with marginal buds
(C) Subterranean root structures
(D) Bark

147. What is the role of chromosomes in the reproductive process?
(A) They synthesize chemical ATP energy for cellular processes
(B) They carry the DNA blueprint from parents to offspring.
(C) They break down food particles.
(D) They form the cell wall.

148. Which among the following does NOT reproduce by spore formation?
(A) Yeast
(B) Rhizopus
(C) Mucor
(D) Penicillium

149. The process of reproduction in single organisms is fundamentally driven by the need to:
(A) Consume more food
(B) Perpetuate the species
(C) Increase the size of the individual
(D) Move to a new location

150. Consider the following statements about Paramecium:
I. It is a unicellular organism.
II. It normally reproduces via transverse binary fission.
III. It can undergo conjugation, which is a form of sexual reproduction.
IV. It reproduces primarily by fragmentation.
Which of the above statements are correct?
(A) I, II and III
(B) I, III and IV
(C) II, III and IV
(D) I and II only

151. Which statement best characterises the difference between a spore and a seed?
(A) Spores are complex multicellular reproductive structures, whereas seeds are strictly unicellular cells.
(B) Spores form asexually in organisms like Rhizopus; seeds form sexually.
(C) Spores always demand prior cross-fertilisation, whereas plant seeds develop entirely without fertilisation.
(D) Spores are exclusively produced by vertebrate animals, whereas seeds are uniquely produced by green plants.

152. In binary fission, what happens to the parent's identity?
(A) It is fully preserved within the structural cellular identity of one primary daughter cell.
(B) It is lost when the parent splits into two new individuals.
(C) It remains behind as an empty, discarded extracellular outer shell after nuclear division.
(D) It encapsulates itself into a dormant, microscopic reproductive spore during division.

153. Tissue culture is a modern technique of growing plants. It is essentially an advanced artificial form of:
(A) Complex sexual reproduction in plants
(B) Vegetative propagation
(C) Multiple fission
(D) Conjugation

154. If yeast is kept in a dry container without sugar, its rate of budding will:
(A) Increase rapidly due to lack of water competition
(B) Remain unaffected
(C) Decrease drastically or stop
(D) Change into binary fission

155. Which of the following is true regarding the cells formed by the regeneration of Planaria?
(A) They change cell types in an organised sequence.
(B) They proliferate as completely random, totally unorganised undifferentiated cell masses.
(C) They specialize rapidly into haploid gametes capable of undergoing fertilisation.
(D) They remain permanently restricted and

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species

95. Match the plants in List I with the parts used for vegetative propagation in List II:

List I: Plants

P. Potato
Q. Sweet potato
R. Bryophyllum
S. Rose

List II: Plant Parts

1. Leaf margins
2. Stem cuttings
3. Stem tuber (Eyes)
4. Root tuber

(A) P-3, Q-4, R-1, S-2
(B) P-4, Q-3, R-1, S-2
(C) P-3, Q-4, R-2, S-1
(D) P-2, Q-4, R-1, S-3

96. Which biological molecule is responsible for carrying the hereditary information from the parent cell to the newly formed daughter cells?
(A) Proteins
(B) Lipids
(C) DNA
(D) Carbohydrates

97. If a Planaria is cut into three distinct pieces (head, middle, tail), what will be the result?
(A) Only the isolated head segment possesses viable tissue to survive and grow.
(B) All three pieces regenerate into complete Planaria.
(C) The severed body pieces automatically re-align and fuse back together completely.
(D) None of the severed body segments are capable of surviving the physical trauma.

98. What ensures that the species does not become extinct upon the death of individual organisms?
(A) Nutrition
(B) Continual reproduction
(C) Extreme biological longevity of individuals
(D) Large physical size

99. In simple multicellular organisms like Spirogyra, reproduction is relatively straightforward because:
(A) They possess specialized, highly developed internal reproductive organ systems.
(B) Their body design is simple, lacking specialized tissues.
(C) They can swim rapidly through aquatic environments to actively seek out mates.
(D) They reproduce exclusively via complex sexual fertilization mechanisms.

100. During binary fission, what happens immediately after the nucleus finishes dividing?
(A) The cytoplasm constricts and divides.
(B) The cell immediately enters an extended, dormant metabolic resting phase.
(C) A thick, impermeable protective cyst wall forms completely around the cell.
(D) Cellular DNA replication initiates all over again almost immediately.

101. Which of the following is NOT an advantage of asexual reproduction?
(A) It requires only a single parent.
(B) It allows for rapid multiplication.
(C) It is energy-efficient as mate-finding is not required.
(D) It produces a high degree of genetic variation.

102. The continuous process of cell division at a specific site in Hydra results in a mass of cells that develops into a:
(A) Tentacle
(B) Spore
(C) Zygote
(D) Bud

103. Which of the following statements about DNA replication in asexual reproduction is most accurate?
(A) It consistently produces two chemically and structurally 100% perfectly identical copies.
(B) Copies are similar, but biochemical variations prevent absolute identity.
(C) It randomly shuffles parental chromosomes during every round of division to yield new traits.
(D) It strictly involves the alignment and crossing-over pairing of homologous chromosomes.

104. Which of the following best describes the offspring of a bacterium that has undergone binary fission?
(A) A hybrid of two parent strains
(B) A clone of the parent cell
(C) A mutated variant incapable of further division
(D) A sexually mature individual

105. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Vegetative propagation is not

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127. If an organism reproduces through spore formation, which group does it most likely belong to?
(A) Mammals
(B) Higher plants like mangoes
(C) Fungi like Rhizopus
(D) Insects

128. What is the role of the cellular apparatus that is built during reproduction alongside DNA copying?
(A) It provides the space and machinery for the new DNA to function.
(B) It functions exclusively to enzymatically break down the old parental DNA strand.
(C) It synthesizes haploid reproductive gametes during cellular mitotic division.
(D) It secretes toxic biological biochemicals to destroy competing neighbor organisms.

129. If the DNA copying mechanism were absolutely 100% accurate with no errors ever, what would be the long-term consequence for the species?
(A) Rapid and unprecedented evolutionary transformation into complex multicellular body forms.
(B) No genetic variation, increasing vulnerability to environmental changes.
(C) A substantial and permanent increase in the overall physical lifespan of individual organisms.
(D) An immediate and complete biological switch from asexual methods to sexual reproduction.

130. Consider the following statements about vegetative propagation:
I. It is faster than growing plants from seeds.
II. It requires two parent plants.
III. The offspring are genetically uniform.
Which of the above statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

131. Which of the following environmental factors typically acts as a trigger for spore formation in fungi?
(A) The continuous presence of excess environmental moisture combined with optimal physiological heat.
(B) Unfavourable conditions like lack of water or extreme heat.
(C) Highly favourable ambient growth conditions coupled with abundant surrounding organic nutrients.
(D) The immediate proximity and biological chemical signals of a compatible fungal mating partner.

132. The primary distinction between the reproduction of a single-celled bacterium and a human is that the bacterium:
(A) Reproduces asexually via cell division
(B) Requires complex internal tissue systems and organ structures
(C) Cannot reproduce
(D) Has no DNA

133. Which process occurs sequentially in yeast reproduction when conditions are highly favourable?
(A) Spore formation followed by encystment
(B) Multiple fission followed by fragmentation
(C) Complex conjugation followed by meiotic reduction division
(D) Chain of buds forming one after another

134. Which of the following is true for fragmentation in Spirogyra?
(A) Every cell in the fragment can divide and grow.
(B) It relies strictly on highly specialized stem-like regenerative cells located throughout the stem.
(C) It routinely occurs long prior to the full physiological maturation of the cell filament.
(D) It requires strong, turbulent water currents to physically tear the plant filament apart.

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135. Match the terms in List I with their descriptions in List II:
List I: Terms
P. Clone
Q. Cyst
R. Spore
S. Bud
List II: Descriptions
1. Protective structure during unfavourable conditions
2. Reproductive unit with thick walls
3. Genetically identical offspring
4. Small outgrowth from the parent body
(A) P-3, Q-1, R-2, S-4
(B) P-1, Q-3, R-2, S-4
(C) P-3, Q-2, R-1, S-4
(D) P-4, Q-1, R-2, S-3

115. Which organism clearly demonstrates that the process of reproduction in single organisms is fundamentally linked to cell division?
(A) Human
(B) Amoeba
(C) Mango tree
(D) Elephant

116. Which process is NOT a type of asexual reproduction?
(A) Budding
(B) Fission
(C) Fertilisation
(D) Fragmentation

117. When a Hydra produces a bud, what must develop before the bud detaches to become an independent organism?
(A) A thick, durable spore wall
(B) Mouth and tentacles
(C) Roots and leaves
(D) A rigid cell wall

118. What distinguishes multiple fission from binary fission?
(A) Multiple fission occurs exclusively in complex multicellular animals, whereas binary fission occurs in unicellular forms.
(B) Multiple fission requires two distinct parent organisms, whereas binary fission requires only a single parent cell.
(C) Multiple fission involves gametes, whereas binary fission proceeds entirely without gamete involvement.
(D) Multiple fission yields many cells at once; binary yields two.

119. A defining characteristic of vegetative propagation is that the new plants are:
(A) Genetically dissimilar to the parent plant
(B) Genetically identical to the parent plant
(C) Produced from the flower of the plant
(D) Unable to produce their own roots

120. Which of the following represents the correct sequence of steps in the regeneration of Planaria?
(A) Body is cut → Specialised cells proliferate → Cells differentiate into various tissues
(B) Cells differentiate → Body is cut → Specialised cells proliferate
(C) Specialised cells proliferate → Body is cut → Cells differentiate
(D) Body is cut → Tissues un-differentiate → Organism dies

121. The rapid reproduction of single organisms plays a crucial role in ecosystems by:
(A) Acting as primary decomposers and nutrient recyclers
(B) Actively predating on large terrestrial and aquatic vertebrates
(C) Producing non-biodegradable waste
(D) Depleting the ozone layer

122. How does the genetic makeup of an Amoeba produced by binary fission compare to its parent?
(A) It contains precisely half the total quantity of genetic material present in the parent.
(B) It contains exactly twice the amount of duplicated nuclear genetic material of the parent.
(C) Identical genetic material, barring minor copying errors.
(D) It contains an equal mix of genetic material combined from two distinct parent Amoebae.

123. The "eyes" on a potato tuber are actually:
(A) Root hairs
(B) Structural scars resulting from feeding insect bites
(C) Nodes bearing buds for vegetative propagation
(D) Seeds

124. Which condition is generally considered unfavourable for the survival and normal binary fission of Amoeba?
(A) High moisture
(B) Optimum environmental temperature and pH
(C) Drying up of the water body
(D) Abundant food supply

125. The process of copying DNA is known to have some built-in tendency for variation. This tendency is the basic foundation for:
(A) Extinction
(B) Evolution
(C) Digestion
(D) Respiration

126. In the context of asexual reproduction, what does the term 'proliferation' mean during regeneration?
(A) Rapid reduction in cell number
(B) Rapid multiplication of specialised cells
(C) Fusion of two different specialized cell types
(D) Death of tissue cells

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(C) Flowers
(D) Extensive underground rhizomes and roots

64. A student observes a slide of yeast and sees a chain of attached cells. What does this indicate?
(A) The yeast culture is actively undergoing multiple fission inside a protective cyst.
(B) The single-celled yeast is reproducing rapidly via symmetrical binary fission.
(C) The individual yeast organism is forming reproductive spores inside a sporangium.
(D) Yeast buds formed sequentially without detaching from the parent.

65. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Amoeba can divide in any plane during binary fission.
Reason (R): Amoeba has a completely irregular body shape and lacks a specific axis of symmetry.
Which of the following options is correct?
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

66. Which type of cell division does NOT involve the generation of significant genetic variation?
(A) Cross-pollination
(B) Sexual reproduction
(C) Conjugation
(D) Asexual reproduction

67. The survival of a species over time is dependent on its ability to:
(A) Move to a new habitat
(B) Maintain a continuously high rate of cellular respiration
(C) Reproduce and generate new individuals
(D) Grow to a very large size

68. What happens to the parent organism after binary fission in Amoeba?
(A) It dies immediately following cellular division and rapidly undergoes enzymatic decay.
(B) It constructs a thick outer cyst wall to protect itself from hostile conditions.
(C) It continues to live as a distinct, single parent entity alongside its offspring.
(D) It loses identity by dividing into two daughter cells.

69. Why is variation, even if minor during asexual reproduction, considered important in biology?
(A) It invariably causes severe genetic diseases and physical defects in offspring.
(B) It forms the basis for evolution and species survival during changes.
(C) It guarantees that all produced offspring are completely exact genetic clones.
(D) It completely halts the fundamental biochemical process of cellular DNA replication.

70. Consider the following statements about Planaria:
I. It can regenerate a whole body from a small fragment.
II. Regeneration is its primary, preferred method of reproduction.
III. The process involves specialised cells proliferating and differentiating.
IV. Planaria is a complex vertebrate organism.
Which of the above statements are correct?
(A) I and II only
(B) I and III only
(C) II and IV only
(D) I, III and IV only

71. The practical importance of rapid reproduction of yeast is utilized in which of the following industries?
(A) Textile industry
(B) Baking and brewing industries
(C) Heavy metallurgical and mining industries
(D) Paper manufacturing

72. Which bacteria is economically important and relies on rapid reproduction to convert milk into curd?
(A) Rhizobium leguminosarum
(B) Salmonella
(C) Lactobacillus
(D) E. coli

73. Which of the following is true about the offspring of a single Hydra produced by budding?
(A) They will have different characteristics from the parent.
(B) They will share half their genetic material with the parent.
(C) They will only survive in an entirely different environment.
(D) They are genetically identical to the parent.

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136. Why is reproduction not considered a life process necessary to maintain the life of an individual organism?
(A) Because the biological process of reproduction consumes no cellular metabolic energy whatsoever.
(B) An individual can live its entire life without reproducing.
(C) Because reproduction is a specialized life process that takes place exclusively within green plants.
(D) Because the act of reproducing results directly in the immediate physiological death of the organism.

137. Which of the following diseases is linked to a protozoan that reproduces via multiple fission?
(A) Tuberculosis
(B) Malaria
(C) Dengue
(D) Cholera

138. What is the fundamental difference in the outcome of mitotic cell division in an Amoeba versus a human skin cell?
(A) In Amoeba it creates an organism; in skin cells it repairs tissue.
(B) In Amoeba, mitosis systematically halves the nuclear chromosome number, whereas in human cells it does not.
(C) In Amoeba, cellular division requires zero ATP chemical energy, whereas in human cells it consumes vast energy.
(D) There is fundamentally no functional biological difference, as both processes yield brand-new organisms.

139. How does asexual reproduction affect the rate of population expansion in suitable environments?
(A) It drastically slows it down.
(B) It keeps the population exactly stable.
(C) It allows for rapid and exponential expansion.
(D) It causes the population size to fluctuate entirely randomly over time

140. Arrange the following steps of spore formation and germination in Rhizopus in the correct order:
I. Hyphae develop sporangia
II. Spores germinate on a moist surface
III. Spores are released into the air
IV. Nucleus divides multiple times inside sporangium to form spores
(A) I, IV, III, II
(B) IV, I, III, II
(C) I, III, IV, II
(D) II, I, IV, III

141. The asexual reproduction method seen in yeast is different from that in Amoeba because:
(A) Yeast routinely divides symmetrically into two equal daughter halves, whereas Amoeba never undergoes equal division.
(B) Amoeba characteristically produces a small external bud, whereas yeast always splits cleanly into two equal halves.
(C) Yeast forms a small bud; Amoeba divides into equal halves.
(D) Amoeba reproduces exclusively through sexual mechanisms, whereas yeast relies strictly on asexual reproduction.

142. A piece of stem from a rose plant is planted in the soil and it grows into a new plant. This is an example of:
(A) Spore formation
(B) Naturally occurring vegetative propagation mechanisms
(C) Artificial vegetative propagation (cutting)
(D) Fragmentation

143. Which characteristic makes Leishmania's binary fission different from that of Amoeba?
(A) It strictly requires an intracellular parasitic host cell to undergo any cellular division.
(B) It divides in a longitudinal plane due to flagellum orientation.
(C) It generates hundreds of resistant microscopic spores inside a specialized sporangium.
(D) It reproduces without undergoing any prior cellular replication of its genomic DNA.

144. What happens when a Planaria is accidentally crushed into several pieces?
(A) It suffers total systemic cellular collapse and dies almost instantaneously upon injury.
(B) Only the physically largest anterior segment survives to regenerate missing structures.
(C) Multiple pieces regenerate into complete individual Planaria.
(D) All severed pieces immediately secrete thick protective cyst walls around themselves.

145. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Plants grown by vegetative propagation bear flowers and fruits earlier than those grown from seeds.

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84. Which of the following is NOT an example of asexual reproduction?
(A) A potato tuber sprouting new plants
(B) A starfish regenerating a lost arm into a whole organism
(C) A pollen grain fertilising an ovule in a flower
(D) Yeast forming a chain of buds

85. What specific part of the cell is the primary site where the blueprint of the organism (DNA) is stored?
(A) Ribosomes
(B) Nucleus
(C) Lysosomes
(D) Golgi apparatus

86. How does the generation time (time taken to reproduce) of bacteria typically compare to that of complex multicellular organisms?
(A) It is much longer due to the biochemical complexity of bacterial cellular walls.
(B) It is precisely identical to the generation times observed in complex mammals.
(C) It is much shorter, allowing rapid population growth.
(D) Bacteria lack a defined generation time because individual cells never undergo death.

87. Under what condition is an Amoeba most likely to form a protective cyst around itself?
(A) When plenty of food is available
(B) Under optimal, highly favourable temperature and moisture levels
(C) Under unfavourable environmental conditions
(D) During the process of catching prey

88. When favourable conditions return, what happens to the encysted Amoeba?
(A) It undergoes multiple fission, producing minute amoebae.
(B) It remains permanently encased inside the protective cyst wall without further division.
(C) It undergoes a radical metabolic transformation into an entirely different protozoan species.
(D) It immediately suffers irreversible structural cellular breakdown and dies due to environmental shock.

89. Which of the following terms is often used to describe the minute amoebae produced by multiple fission inside a cyst?
(A) Gametes
(B) Pseudopodiospores
(C) Zygotes
(D) Multicellular megaspores

90. Consider the following statements about spores:
I. They are reproductive structures capable of growing into new individuals.
II. They have thin, delicate walls for easy germination.
III. They help the organism tide over unfavourable conditions.
Which of the above statements is/are correct?
(A) I and II
(B) I and III
(C) II and III
(D) III only

91. The energy required for cell division and the synthesis of new cellular components during reproduction is primarily supplied by:
(A) DNA
(B) ATP
(C) RNA
(D) Chlorophyll

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92. Why is water/moisture a critical environmental factor for the germination of spores?
(A) It directly supplies the chemical ATP energy necessary to initiate spore germination.
(B) It chemically dissolves the thick protective spore wall so nuclear DNA can escape freely.
(C) It reactivates metabolic processes needed for spore growth.
(D) It acts as a natural toxin that effectively kills competing surrounding fungal spores.

93. A key difference between budding in yeast and budding in Hydra is that:
(A) Yeast is unicellular while Hydra is multicellular.
(B) Budding in yeast is sexual while in Hydra it is asexual.
(C) Yeast buds always detach immediately, while Hydra buds form long chains.
(D) Yeast requires gametes to bud, Hydra does not.

94. The ability of an organism to produce new individuals from a single body part is a characteristic of:
(A) Animals only
(B) Plants only
(C) Certain plants, animals, and microorganisms
(D) Only highly complex vertebrate animal

cannot ever form complex specialized nerve tissues.

156. An Amoeba reproduces by dividing in two. The two new Amoebae grow and then divide again. Assuming all survive, how many Amoebae will exist after 3 rounds of division starting from one individual?
(A) 4
(B) 6
(C) 8
(D) 10

157. Which feature is unique to multiple fission compared to other forms of asexual reproduction?
(A) It strictly yields only two genetically identical daughter cell clones per parent organism.
(B) It forms a cyst and undergoes repeated nuclear divisions.
(C) It occurs exclusively under highly optimal, moist, and temperature-favourable conditions.
(D) It necessitates the physical presence and cellular fusion of two distinct parent cells.

158. The thread-like structures of Rhizopus that spread over the bread slice are:
(A) Photosynthetic
(B) Non-reproductive vegetative structures
(C) Specialized reproductive fungal structures
(D) Roots of a plant

159. What is the fundamental difference between reproduction in Amoeba and reproduction in a dog?
(A) Amoeba reproduces exclusively via sexual fertilization, whereas the dog reproduces asexually.
(B) Amoeba divides as a single cell; dogs require two parents and gametes.
(C) Amoeba functions entirely without cellular DNA during reproduction, whereas the dog requires DNA.
(D) Both organisms reproduce using identical cellular strategies, but Amoeba accomplishes it much faster.

160. Which sequence correctly represents the general steps of asexual reproduction in a unicellular organism?
(A) DNA replicates → Nucleus divides → Cytoplasm divides
(B) Cytoplasm divides → DNA replicates → Cell grows
(C) Nucleus divides → DNA replicates → Cytoplasm divides
(D) Cytoplasm divides → Nucleus divides → DNA replicates

161. A clone is a group of individuals obtained through:
(A) Self-pollination
(B) Natural cross-pollination
(C) Asexual reproduction
(D) Sexual reproduction

162. Why is the creation of cellular apparatus essential during DNA copying?
(A) DNA requires cellular machinery to function and survive in new cells.
(B) Because the surrounding cellular apparatus actively synthesizes and creates new DNA molecules from scratch.
(C) To systematically degrade and destroy the old outer cell membrane during nuclear division.
(D) To construct external locomotive organelles like flagella so the new cell can swim away.

163. The ability of a cut stem of sugarcane to grow into a whole plant is attributed to:
(A) Budding
(B) Vegetative propagation
(C) Spore-based propagation
(D) Regeneration

164. What happens when the sporangium of Rhizopus bursts?
(A) Liquid water stored inside the sporangium is forcefully released into surrounding environment.
(B) Motile sexual gametes are released into the surrounding air to actively seek out a mate.
(C) Spores disperse into the air to germinate on moist surfaces.
(D) A newly formed microscopic vegetative bud appears immediately at the site of rupture.

165. Which of the following defines 'karyokinesis'?
(A) Division of the cytoplasm
(B) Division of the nucleus
(C) Formation of a bud
(D) Duplication of ribosomes

166. Which type of cell division is predominantly associated with asexual reproduction?
(A) Meiosis
(B) Mitosis
(C) Both Meiosis and Mitosis equally

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(D) Neither Meiosis nor Mitosis

167. In what way does limited genetic diversity due to asexual reproduction pose a threat to a species?
(A) It causes individual organisms to continuously absorb nutrients and grow excessively too large.
(B) A new disease or environmental change could wipe out identical populations.
(C) It completely halts metabolic digestion, stopping organisms from consuming surrounding food.
(D) It causes all produced offspring to gradually become sterile and incapable of reproduction.

168. Which of the following is true about the rate of reproduction?
(A) It operates completely independently of cellular metabolic energy or nutrient availability.
(B) It requires ATP energy to synthesize macromolecules and cell structures.
(C) It reaches its maximum biological rate when organisms are placed in freezing temperatures.
(D) It depends strictly and exclusively upon the overall physiological age of the organism.

169. What role does asexual reproduction play in industrial microbiology (e.g., yeast in brewing)?
(A) It allows for the intentionally slow, highly controlled, and steady production of diverse mixed traits.
(B) It rapidly produces large numbers of identical microbes for fermentation.
(C) It spontaneously generates completely brand-new biological species of industrial yeast within hours.
(D) It acts as a natural biochemical control mechanism that strictly limits the total production of alcohol.

170. Consider the following statements about DNA in reproduction:
I. DNA molecules contain the information for inheritance of features.
II. DNA is the information source for making proteins.
III. Changes in DNA information lead to changes in the proteins made.
Which of the above statements are correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II and III

171. If an organism's reproduction strategy results in completely identical offspring with no genetic variation over thousands of generations, what is its likely mode of reproduction?
(A) Purely sexual reproduction
(B) Alternation of generation cycles
(C) Purely asexual reproduction
(D) Cross-fertilisation

172. A key observable difference between fragmentation in Spirogyra and regeneration in Planaria is:
(A) Spirogyra is a complex multicellular vertebrate animal, whereas Planaria is a photosynthetic plant.
(B) Fragmentation occurs at maturity; regeneration often needs accidental injury.
(C) Fragmentation strictly requires male and female gametes, whereas regeneration proceeds without them.
(D) Regeneration is a process that occurs exclusively in deep ocean water, whereas fragmentation occurs on dry land.

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173. What is the primary function of the nucleus in the process of binary fission?
(A) To actively break down and digest cellular food particles within surrounding vacuoles.
(B) To coordinate division and distribute replicated genetic material.
(C) To provide rigid mechanical support and structural protection to the outer cell wall.
(D) To act as a protective external boundary barrier against ambient environmental stress.

174. Which of the following structures is responsible for maintaining the genetic continuity in single-celled organisms during reproduction?
(A) Plasma membrane
(B) Contractile vacuole
(C) Chromosomes
(D) Mitochondria

175. Match the organisms in List I with their specific characteristics during reproduction in List II:
List I: Organisms
P. Amoeba
Q. Leishmania
R. Yeast
S. Rhizopus
List II: Characteristics

1. Divides in a definite longitudinal plane
2. Divides in any plane
3. Forms sporangia
4. Forms unequal buds

(A) P-2, Q-1, R-4, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-2, Q-1, R-3, S-4
(D) P-4, Q-3, R-2, S-1

176. What happens to the rate of binary fission in bacteria if they are moved from a nutrient-rich warm environment to a freezing environment with no nutrients?
(A) It increases dramatically.
(B) It remains completely unchanged.
(C) It decreases drastically or stops.
(D) They immediately switch to spore formation.

177. Which of the following best describes the structural organisation of Spirogyra that allows it to reproduce by fragmentation?
(A) Highly complex structural organisation containing distinct internal organ systems and vascular tissue.
(B) Microscopic single-celled unicellular organism completely lacking a distinct nuclear membrane.
(C) Simple multicellular, filamentous design lacking tissue differentiation.
(D) Densely covered in a thick, impermeable layer of woody bark and protective plant cuticles.

178. The cells that actively divide and differentiate during regeneration in Hydra are:
(A) Differentiated epidermal dead skin cells
(B) Red blood cells
(C) Specialised regenerative cells
(D) Gametes

179. If a population of cloned bacteria is exposed to a new, lethal antibiotic, what is the most likely outcome?
(A) They will all rapidly mutate and quickly evolve complete enzymatic resistance to the antibiotic.
(B) They will likely all die, sharing the same genetic vulnerability.
(C) Exactly half of the bacterial population will survive, while the remaining half will die off.
(D) They will immediately switch modes to reproduce sexually in order to survive the treatment.

180. Arrange the following events of budding in Hydra in chronological order:
I. Bud develops mouth and tentacles
II. Outgrowth appears due to repeated cell division
III. Bud detaches to become an independent organism
IV. Bud grows in size

(A) II, IV, I, III
(B) I, II, III, IV
(C) II, I, IV, III
(D) IV, II, I, III

181. What prevents a complex multicellular organism like a mammal from reproducing by fragmentation?
(A) Mammals do not possess sufficient metabolic chemical energy to perform tissue fragmentation.
(B) Mammals have highly organised organ systems, not simple cell clusters.
(C) Mammals do not contain cellular DNA within their specialized tissues and organ systems.
(D) Mammals inhabit terrestrial habitats on land rather than living directly in aquatic water.

182. During binary fission, the process of cytokinesis refers specifically to:
(A) Division of the nucleus
(B) Division of the cytoplasm
(C) Precise replication of nuclear DNA
(D) Formation of a cyst

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183. Vegetative propagation is practically important in agriculture because it is the only way to propagate:
(A) Commercial wheat and cereal crops
(B) Maize
(C) Seedless grapes and bananas
(D) Rice

184. In terms of genetic similarity, how do the daughter cells of binary fission compare to each other?
(A) They are completely different.
(B) They share exactly 50% of their total parental DNA content
(C) They are essentially identical to each other.
(D) One receives all the DNA, the other receives none.

185. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Minor variations occur during DNA replication in asexual reproduction.
Reason (R): The biochemical reactions involved in copying DNA are not absolutely reliable.
Which of the following options is correct?
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

186. Which of the following is NOT an example of vegetative propagation?
(A) Growing a new rose plant from a stem cutting
(B) A potato tuber sprouting from an 'eye'
(C) Growing a new plant from a seed
(D) A new Bryophyllum plant growing from a leaf margin

187. The thick wall of a spore allows it to survive extreme conditions. Once the spore lands on a moist, warm surface, the wall:
(A) Becomes substantially thicker and harder
(B) Ruptures to allow the spore to germinate
(C) Turns into a seed
(D) Produces poison

188. In the context of reproduction, which process ensures the stability of the DNA amount from generation to generation in asexually reproducing organisms?
(A) Halving the overall cellular DNA content systematically prior to every single division.
(B) Near-exact DNA replication followed by a single cell division.
(C) Fusing two distinct cellular nuclei together to double the chromosome number each time.
(D) Completely discarding half of the internal cellular chromosomes during mitotic division.

189. A student cuts a Hydra into two halves. What will likely happen?
(A) Both severed halves will immediately undergo cellular lysis and die.
(B) Both halves regenerate into two complete Hydra.
(C) Only the upper anterior half containing tentacles will manage to survive.
(D) The two severed halves will automatically fuse back together in minutes.

190. Consider the following statements about the limitations of asexual reproduction:
I. It does not introduce new traits rapidly.
II. It makes populations susceptible to environmental changes.
III. It results in a very slow increase in population size.
IV. It produces clones.
Which of the above statements describe limitations or consequences of those limitations?
(A) I, II and III
(B) I, II and IV
(C) II, III and IV
(D) I and III only

191. Why is the rapid rate of reproduction in microorganisms beneficial for nutrient cycling in the ecosystem?
(A) They rapidly break down dead organic matter.
(B) They absorb and completely consume all incoming solar sunlight in aquatic layers.
(C) They continuously produce lethal toxic gases that eradicate upper-level predators.
(D) They completely halt and disrupt the natural atmospheric carbon cycling process.

192. Which cellular component is absolutely necessary to assemble the new cellular apparatus during cell division?
(A) Photosynthetic chloroplast organelle systems
(B) Food vacuole
(C) Ribosomes (protein synthesis machinery)
(D) Flagellum

193. The term 'binary' in binary fission refers to:
(A) The capacity of a single organism to reside across two distinct ecological habitats.
(B) The splitting of a parent cell into two daughter cells.
(C) The absolute biological requirement of two separate parent organisms for mating.
(D) The persistent presence of two fully functional nuclei within one parent cell.

194. Which of the following is considered the most primitive and simplest method of reproduction among unicellular organisms?
(A) Regeneration
(B) Binary fission
(C) Spore formation

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(D) Vegetative propagation

195. The reproductive parts of an angiosperm (flowering plant) are located in the flower. In contrast, vegetative propagation relies on:
(A) The male stamen and female pistil
(B) The root, stem, or leaves
(C) The seeds and fruits
(D) The pollen grains

196. Organisms well-adapted to a stable environment will generally have:
(A) A remarkably low reproduction rate due to minimal selective environmental pressure.
(B) A high reproduction rate using asexual means.
(C) Complete absence of any biological need to undergo further reproduction.
(D) An extraordinarily high rate of cellular genetic mutation across generations.

197. Which unicellular organism exhibits a combination of both asexual (binary fission) and primitive sexual (conjugation) reproduction methods?
(A) Amoeba
(B) Leishmania
(C) Paramecium
(D) Yeast

198. The primary biological significance of mitosis in single-celled organisms is:
(A) Production of gametes
(B) Asexual reproduction
(C) Increasing the size of the single cell
(D) Decreasing genetic material

199. What distinguishes the outgrowth in yeast (bud) from the outgrowth in Hydra (bud) during the early stages?
(A) Yeast buds are complex multicellular cellular masses, whereas Hydra buds are strictly single unicellular structures.
(B) Yeast buds routinely form by perfectly equal symmetrical division, whereas Hydra buds develop via unequal division.
(C) Yeast buds are single cells from unequal division; Hydra buds are multicellular.
(D) There is fundamentally no observable structural difference, as both buds are always produced at exactly the same size.

200. In summary, why is asexual reproduction considered a double-edged sword for a species?
(A) It demands enormous cellular metabolic energy reserves while producing extremely few offspring per cycle.
(B) It enables rapid population growth but lacks variation for adapting.
(C) It progresses at an extremely slow biological pace but produces exceptionally well-adapted offspring.
(D) It strictly necessitates two individual parents for every cycle while guaranteeing species survival.

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expands an existing organism, reproduction ensures the survival and continuation of the species.

40. (C) Cell growth → Karyokinesis → Cytokinesis
Binary fission in Amoeba follows a precise chronological sequence. First, the fully grown cell reaches maximum size and replicates its DNA. Next, karyokinesis takes place as the nucleus elongates and divides into two separate nuclei. Finally, cytokinesis occurs, during which the cytoplasm constricts and divides, ultimately splitting the cell into two daughter amoebae.

41. (A) To colonise favourable habitats rapidly and form food web bases.
Unicellular organisms like bacteria and algae use rapid asexual reproduction to multiply exponentially when nutrients and environmental conditions are favourable. This fast population expansion allows them to quickly colonize available habitats and produce large biomasses, forming the primary producer and decomposer bases that sustain energy flow throughout ecological food webs.

42. (D) Conjugation
Conjugation is a process observed in certain unicellular organisms like Paramecium, where two individual cells temporarily pair to exchange nuclear genetic material. Although it does not directly increase cell numbers, conjugation reconstitutes genetic diversity and vigor in the population, representing a primitive sexual mechanism distinct from standard asexual binary fission.

43. (B) They undergo rapid binary fission without needing mate selection.
Bacterial populations can grow exponentially because they reproduce asexually through simple binary fission, which requires no time or energy for mate location or complex tissue development. Under ideal environmental conditions with abundant nutrients, a single bacterium can duplicate its DNA and divide every few minutes, causing population numbers to double rapidly.

44. (A) The rate decreases, and protective structures like cysts may form.
When environmental conditions become harsh due to extreme temperatures, drought, or nutrient exhaustion, single-celled organisms reduce their metabolic and reproductive rates to conserve energy. Many protozoans secrete thick, protective cyst walls around themselves, entering a dormant state to survive hostile surroundings until favourable growth conditions eventually return to the habitat.

45. (D) Nucleus (or nucleoid)
Before a unicellular organism can successfully divide into two functional, viable cells, its nucleus or nucleoid region must duplicate. The genetic material contained within this nuclear region holds the essential biological instructions for cellular metabolism and structure, ensuring that each resulting daughter cell inherits a complete genome necessary for independent survival.

46. (B) No, the cytoplasm divides unequally, forming a smaller bud.
During budding in yeast, nuclear division is accompanied by an unequal division of the cytoplasm. Instead of splitting into two equal halves like binary fission, the parent cell forms a small external protuberance into which one of the daughter nuclei migrates. The resulting bud is initially much smaller than the parent cell.

47. (A) ATP (Adenosine Triphosphate)
Adenosine Triphosphate, commonly known as ATP, serves as the primary biochemical energy currency within living cells. The complex metabolic processes associated with cellular reproduction, including DNA replication, enzyme synthesis, and cytoplasmic division, rely directly on the chemical energy released by ATP hydrolysis to drive these essential cellular activities forward.

48. (D) They are adapted to thrive in those specific stable conditions.
In a constant, unchanging environment, producing offspring that are genetically identical to the parent is advantageous. Since the parent organism possesses traits well-suited for survival and reproduction in that specific habitat, passing down the exact same genetic combination ensures that the offspring will remain equally adapted to thrive in those conditions.

49. (D) Colour of the surroundings
Microorganisms depend heavily on environmental factors such as ambient temperature, moisture levels, pH, and nutrient availability to drive their metabolic processes and cell division. In contrast, the visual colour of the surrounding

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10. (B) II and III only
Binary fission is an asexual reproductive process involving only a single parent cell, making statement I incorrect. During this division, the single parent splits symmetrically into two equal daughter cells, which is correctly described in statement II. Statement III is also accurate because binary fission represents the primary, highly efficient method of asexual reproduction commonly observed in bacteria.

11. (D) Hydra
Hydra is a simple multicellular aquatic animal that uses specialized regenerative cells to undergo budding. Repeated cell divisions occur at a specific site on its body wall, producing a small outgrowth called a bud. This bud gradually matures, develops a mouth and tentacles, and eventually detaches from the parent organism to live independently as a complete new individual.

12. (C) Repeated cell division at one specific site
In Hydra, budding is initiated by repeated cell divisions at a specific location on the body wall, driven by specialized regenerative cells. This localized proliferation leads to the development of a small protuberance or outgrowth known as a bud. The bud continues to grow and differentiate into a tiny young organism, complete with a mouth and surrounding tentacles.

13. (C) Yeast
Yeast is a microscopic unicellular fungus that reproduces asexually by budding under favourable nutritional conditions. During this process, a small protuberance develops on the outer wall of the parent cell while the nucleus divides. One daughter nucleus migrates into the growing bud, which may eventually detach or remain attached to form temporary chains of interconnected yeast cells.

14. (D) They detach from the parent body and become independent individuals.
During budding in Hydra, the developing outgrowth remains attached to the parent body while receiving nutrients and undergoing cellular differentiation. Once the young individual fully matures, forming its own mouth and tentacles, it breaks away from the parent organism. It then settles in the surrounding aquatic environment to function as an independent, free-living organism.

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15. (A) P-4, Q-1, R-3, S-2
Different organisms utilize specific asexual reproductive strategies. Amoeba undergoes binary fission to divide into two equal daughter cells. Plasmodium reproduces through multiple fission inside a cyst, producing many daughter cells at once. Hydra reproduces by budding from specialized regenerative cells. Planaria exhibits extensive regeneration, rebuilding complete bodies from small severed body fragments.

16. (B) Regeneration
Regeneration is the biological process by which certain organisms reconstruct a complete, fully functional body from small severed fragments. In Planaria, specialized cells at the cut site proliferate rapidly to form a mass of cells. These cells then undergo structured differentiation into various tissue types, successfully re-establishing all missing body parts and organs of the individual.

17. (D) It is a type of sexual reproduction.
Regeneration relies entirely on somatic cell division and tissue differentiation without any involvement of gametes or fertilisation, making it an asexual process rather than a sexual one. Organisms like Planaria can regenerate complete bodies from small fragments through organized proliferation and differentiation of specialized cells. Therefore, classifying regeneration as a mode of sexual reproduction is completely incorrect.

18. (B) Because most organisms cannot normally wait to be cut up to reproduce.
Regeneration is primarily a repair mechanism that allows organisms to recover from physical injury or body fragmentation. Under normal ecological conditions, organisms do not rely on accidental cutting or damage as their primary method to create offspring. Instead, species depend on regular, structured reproductive processes like fission, budding, or sexual reproduction to ensure consistent population expansion.

19. (D) Fragmentation
Spirogyra is a simple green alga with a filamentous structural organization. Upon reaching maturity, the long algal filament breaks into smaller pieces called fragments. Each individual fragment undergoes continuous cell division and growth to develop into a fully functional, complete algal

ANSWERS

1. (D) Reproduction
Biological processes like respiration, nutrition, and excretion are vital for the survival of an individual organism. However, reproduction is unique because it enables living organisms to create new individuals of their own kind. This continuous creation of offspring across successive generations ensures that a species does not become extinct, thereby maintaining its overall biological continuity over long periods.

2. (C) Production of new offspring from a single parent without gamete fusion
Asexual reproduction is a mode of multiplication where offspring are produced by a single parent entity. This mechanism occurs entirely without the formation or fusion of specialized sex cells, known as gametes. As a result, the newly generated individuals are genetically identical to the single parent organism and receive an exact copy of the parental genetic material during division.

3. (B) Mitosis
Unicellular organisms generally reproduce asexually through mitotic cell division. During this process, a single cell duplicates its genetic material and divides symmetrically into two daughter cells. Unlike meiosis, which is a reduction division that produces haploid gametes, mitosis maintains the original chromosome number, resulting in two genetically identical unicellular individuals that can function independently in their environment.

4. (D) Amoeba
Amoeba is a single-celled protozoan that primarily reproduces through binary fission under favourable conditions. During binary fission, the single parent cell duplicates its genetic material, elongates its nucleus, and undergoes cytoplasmic division to split into two separate, equal daughter cells. Other organisms like Hydra, Rhizopus, and Spirogyra utilize budding, spore formation, and fragmentation, respectively.

5. (A) Any plane
Amoeba is a unicellular organism that possesses an irregular body shape without a fixed axis of symmetry. Because it lacks a defined orientation or specialized structural organs, the nuclear and cytoplasmic division during binary fission can occur across any plane. The organism simply elongates its body and splits into two daughter cells regardless of the structural direction chosen.

6. (C) Longitudinal plane
Leishmania is a protozoan parasite that features a whip-like flagellum fixed at one specific end of its elongated body. Because of this distinct structural organization and fixed body axis, binary fission takes place in a strict longitudinal plane. The division begins near the flagellar structure and proceeds along the lengthwise axis, yielding two identical daughter organisms.

7. (A) Plasmodium
Plasmodium, the malarial parasite, reproduces asexually through multiple fission during specific stages of its life cycle. Under unfavourable conditions or inside a host cell, a protective cyst forms around the parent organism. The nucleus within the cyst divides repeatedly into numerous daughter nuclei, which subsequently isolate small portions of cytoplasm to form many daughter cells simultaneously upon release.

8. (D) Division of the nucleus
Binary fission in a fully grown Amoeba begins with nuclear division, also known as karyokinesis. The single nucleus elongates and undergoes mitotic division to divide its replicated genetic material equally between two future cells. Only after nuclear division is successfully completed does the cytoplasm begin to constrict and divide during cytokinesis, ultimately creating two independent daughter cells.

9. (B) Bud
A bud is a small outgrowth that forms on the body of a parent organism as a result of localized, repeated cell divisions. Over time, this cellular projection grows, develops basic structural organs, and receives essential nutrients from the parent. Once fully developed, it detaches from the main body to exist as an independent, genetically identical individual entity.

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30. (A) I, II, and IV
Bacteria reproduce asexually through binary fission, duplicating their genetic material before dividing into two cells, making statements I, II, and IV correct. Favourable conditions lead to rapid, exponential population growth. Statement III is incorrect because bacteria are prokaryotic organisms lacking a true membrane-bound nucleus and do not form mitotic spindle fibers during division.

31. (D) Offspring of asexual reproduction are essentially identical to the parent.
Asexual reproduction involves a single parent without the fusion of gametes or major genetic recombination. Consequently, the resulting offspring are exact genetic copies, or clones, of the parent organism. In contrast, sexual reproduction combines genetic material from two parents, creating unique combinations that lead to significant genetic variation among offspring.

32. (C) It limits genetic diversity, increasing vulnerability to environmental changes.
A major limitation of asexual reproduction is the lack of genetic variation among offspring, as they inherit identical DNA from a single parent. In a changing or hostile environment, such as during a disease outbreak or temperature shift, all individuals share the same genetic vulnerabilities, significantly increasing the population's risk of extinction.

33. (B) DNA replication
The central event in cellular reproduction is the accurate duplication of genetic material, known as DNA replication. DNA stores all the hereditary information needed to direct cellular structure and function. By making a copy of its DNA, a parent cell ensures that each newly formed daughter cell receives the necessary instructions to survive and develop.

34. (B) Inside the nucleus
In a eukaryotic cell, the vast majority of genetic material is located inside the membrane-bound nucleus. DNA is packaged into structures called chromosomes, which contain the hereditary blueprints driving cellular growth, metabolism, and reproduction. Prior to cell division, these nuclear chromosomes undergo replication to prepare for distribution into daughter cells.

35. (A) Because DNA copying alone cannot sustain life without cell structure.
DNA replication provides the genetic instructions for a new cell, but naked DNA cannot survive or function independently. A complete cellular apparatus, including a cell membrane, cytoplasm, and functional organelles, must be synthesized to house the replicated DNA. This structural framework provides the biological environment necessary for metabolic processes and gene expression.

36. (D) Mitosis
Mitosis is the process of nuclear division that ensures each daughter cell receives an exact copy of the parent cell's replicated DNA. During mitosis, chromosomes condense, align, and separate equally into two emerging nuclei. This precise division maintains the chromosome number across somatic cell generations, enabling proper growth, tissue repair, and asexual reproduction.

37. (B) No, unreliable biochemical copying processes produce minor variations.
The biochemical reactions responsible for copying DNA during cellular reproduction are highly accurate but not completely foolproof. Subtle inaccuracies occur during the enzymatic replication process, resulting in minor structural changes or mutations in the base sequences. Consequently, the two resulting DNA copies are extremely similar but not always 100% structurally identical to each other.

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38. (A) A limited amount of genetic variation
Inaccuracies during the DNA replication process introduce subtle structural changes into the genetic code. While these minor copying errors are usually small enough to keep the newly formed cell viable, they generate a baseline level of genetic variation among asexually produced offspring. This subtle diversity provides raw material for natural selection over evolutionary time.

39. (D) Growth increases mass or size; reproduction creates new offspring.
Growth refers to the biological increase in an organism's physical size, cellular volume, or total biomass over time. In contrast, reproduction is the specific process by which living organisms generate new, independent individuals of the same species. While growth maintains and

filament, illustrating the straightforward process of asexual reproduction known as fragmentation.

20. (B) Because their cells are organised into specialized tissues and organs.
Complex multicellular organisms possess structural organization where cells are grouped into specialized tissues, organs, and organ systems with fixed positions. Unlike simple multicellular forms, these differentiated cells cannot randomly divide or revert to an unspecialized state to recreate a whole organism. Therefore, simple cell-by-cell division or fragmentation is impossible for reproducing such intricate biological structures.

21. (A) Hyphae
In the bread mould fungus Rhizopus, the thread-like, non-reproductive structures that spread across the substrate are called hyphae. These microscopic, branching filaments form a vegetative network known as the mycelium, which functions primarily to anchor the fungus and absorb nutrients from the organic matter rather than participating directly in the production of offspring.

22. (D) Sporangia
In Rhizopus, the tiny knob-like structures situated at the tips of upright reproductive hyphae are called sporangia. These structures resemble small blobs on a stick and contain specialized reproductive units called spores. When the sporangia mature, they enclose these microscopic cells until they are ready to be released into the environment for dispersal.

23. (C) Spores
Sporangia are specialized structures in Rhizopus that enclose numerous microscopic reproductive units called spores. Each spore contains a nucleus and cytoplasm protected by a durable outer coating. When released into the air, these spores land on suitable, moist organic surfaces where they germinate and grow into new thread-like Rhizopus individuals.

24. (A) To protect the spore until it reaches a suitable moist surface to grow
Spores produced by organisms like fungi are encased in thick, durable protective walls. This structural adaptation shields the delicate inner cytoplasm and genetic material from harsh environmental conditions, such as extreme dryness, high temperatures, and lack of nutrients. The spore remains dormant inside this protective coat until it finds a moist, warm substrate.

25. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Yeast cells reproduce rapidly via budding when placed in a sugar solution because sugar serves as an abundant substrate for cellular respiration. Respiration breaks down sugar to generate adenosine triphosphate, which provides the metabolic chemical energy needed for rapid nuclear division, cytoplasmic synthesis, and bud formation during asexual reproduction.

26. (D) Vegetative propagation
Vegetative propagation is an asexual mode of reproduction in plants where new individuals develop from vegetative organs such as roots, stems, and leaves. Because this process skips the formation of flowers, seeds, and gamete fusion, the resulting plants are genetically identical to the parent, enabling rapid multiplication of desirable plant traits.

27. (D) Leaf margins
Bryophyllum reproduces vegetatively through adventitious buds that develop along the notches of its leaf margins. When these fleshy leaves mature and fall onto moist soil, the small marginal buds sprout tiny roots and stems. They utilize stored nutrients from the parent leaf to develop into independent young plantlets that grow into mature plants.

28. (A) It enables seedless plants that lost seed capacity to reproduce.
Vegetative propagation allows plants that have lost the capacity to produce viable seeds, such as commercial bananas, seedless grapes, and oranges, to reproduce efficiently. This method utilizes roots, stems, or leaves to generate complete new plants, ensuring that desirable traits are preserved without relying on seed germination or sexual fertilisation.

29. (C) Transverse binary fission
Paramecium is a single-celled ciliated protozoan that has a fixed, slipper-like body shape. It typically reproduces asexually through transverse binary fission, where the cell splits horizontally across its shorter axis. The nuclear material duplicates and divides, followed by cytoplasmic constriction, producing two genetically identical daughter cells oriented side by side.

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physical environment has no biochemical impact on cellular respiration, DNA replication, or the rate of asexual reproduction in microbial populations.

50. (B) I and II only
DNA replication is necessary because it ensures the transmission of genetic traits to subsequent generations, validating statement I. It also provides daughter cells with the instructions required to synthesize functional proteins, supporting statement II. Statement III is incorrect because DNA replication in asexual reproduction yields genetically similar offspring rather than completely different ones.

51. (D) Sugarcane, Rose, and Grapes
Vegetative propagation is widely used in commercial agriculture and horticulture to cultivate crops like sugarcane, roses, and grapes. These plants are grown using stem cuttings, layering, or grafting, allowing farmers to rapidly produce uniform crops with desirable traits while avoiding the longer, variable timelines associated with growing plants from seeds.

52. (B) Vegetatively raised plants bear flowers and fruits earlier than seed-grown ones.
A key advantage of vegetative propagation in agriculture is that plants developed from vegetative parts bypass the lengthy juvenile growth phase required for seed germination and seedling establishment. Consequently, vegetatively propagated plants achieve reproductive maturity much faster, allowing them to produce flowers, fruits, and economic yields earlier than seed-derived plants.

53. (D) Clones
Offspring produced through asexual reproduction inherit genetic material from a single parent without gametic fusion or recombination. As a result, these individuals are morphological and genetic exact copies of their parent. In biological terminology, a group of such genetically uniform individuals derived from a single parent cell is referred to as clones.

54. (A) Maintaining chromosome numbers in daughter cells.
Mitosis is an equational division process where a parent cell duplicates its genetic material and distributes equal chromosome sets into two daughter nuclei. In single-celled organisms, mitosis maintains the exact parental chromosome number, ensuring that each new individual retains complete, stable genetic information identical to the parent cell for proper biological functioning.

55. (A) P-2, Q-4, R-1, S-3
Paramecium undergoes binary fission along a transverse plane, whereas Leishmania splits along a specific longitudinal plane aligned with its flagellum. Bacteria reproduce rapidly through binary fission without forming a membrane-bound nucleus or mitotic apparatus. Plasmodium survives environmental stress by forming a protective cyst inside which it divides into multiple cells.

56. (D) Leishmania
Leishmania is a unicellular protozoan that possesses a distinct, fixed body shape featuring a long, whip-like flagellum at one end. Because of this specialized structural feature, binary fission takes place in a highly organized, definite longitudinal orientation relative to the flagellum, unlike Amoeba, which divides across any arbitrary plane.

57. (D) Biochemical reactions
The biological synthesis of a DNA copy during cell division relies on a complex sequence of biochemical reactions. Enzymes like DNA polymerase assemble nucleotides, unwind double strands, and proofread sequences. Without these precise chemical pathways, cells cannot duplicate their genetic code to distribute identical hereditary material into newly forming daughter cells.

58. (B) Malaria
Plasmodium is a single-celled protozoan parasite responsible for causing malaria in humans. It utilizes multiple fission as a reproductive and survival strategy inside host red blood cells and liver tissue. Within protective cysts, repeated nuclear divisions generate dozens of merozoites, which are released simultaneously to infect additional host cells.

59. (D) An elongated nucleus and a constriction in the cytoplasm
Under a microscope, an Amoeba undergoing binary fission can be identified by key nuclear and cytoplasmic changes. The single nucleus elongates and begins to split into two daughter

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like nitrogen and carbon back into the soil and atmosphere for plants.

122. (C) Identical genetic material, barring minor copying errors.
Binary fission in Amoeba relies on equational mitotic cell division to duplicate and distribute nuclear DNA between two daughter cells. Because no sexual recombination or gametic mixing takes place, the offspring inherit genetic material virtually identical to the parent organism, apart from occasional minor inaccuracies occurring during biochemical DNA replication.

123. (C) Nodes bearing buds for vegetative propagation
The "eyes" observed on a potato tuber represent specialized nodes located on a swollen underground stem. Each eye contains dormant vegetative buds surrounded by scale leaf scars. When exposed to moist soil and warm conditions, these buds sprout roots and shoots, developing into complete new potato plants via vegetative propagation.

124. (C) Drying up of the water body
Amoeba requires a moist, aquatic environment to maintain its metabolic activities, pseudopodial movement, and standard binary fission. The drying up of its surrounding water body represents a highly unfavourable environmental condition, triggering the Amoeba to halt normal cell division and secrete a thick protective cyst to survive until water returns.

125. (B) Evolution
DNA copying involves biochemical reactions that occasionally produce minor inaccuracies or mutations. These subtle variations accumulate across generations, introducing new genetic traits into a population. This inherent tendency for variation provides the raw genetic diversity necessary for natural selection to act upon, driving the long-term process of biological evolution.

126. (B) Rapid multiplication of specialised cells
In the context of regeneration and tissue repair, 'proliferation' refers to the rapid multiplication of specialized stem-like cells at the injury site. These proliferating cells divide repeatedly to form a large mass of unorganized tissue, which subsequently undergoes organized differentiation to reconstruct missing body parts of the organism.

127. (C) Fungi like Rhizopus
Spore formation is a characteristic mode of asexual reproduction widely observed in fungi such as Rhizopus, Penicillium, and Mucor. These organisms produce specialized structures called sporangia that release microscopic spores into the air, enabling them to disperse, survive dry conditions, and germinate into new fungal hyphae upon landing on moist substrate.

128. (A) It provides the space and machinery for the new DNA to function.
When a cell duplicates its DNA during reproduction, it must simultaneously synthesize a complete cellular apparatus, including cytoplasm, cell membrane, and organelles. This newly constructed framework provides the physical space, structural boundary, and biochemical metabolic machinery required for the replicated DNA to function properly in the daughter cell.

129. (B) No genetic variation, increasing vulnerability to environmental changes.
If DNA replication were completely error-free with zero inaccuracies, no genetic variations would ever arise in asexually reproducing species. While offspring would remain identical to parents, the lack of genetic diversity would leave the entire species highly vulnerable to environmental shifts, diseases, or climate changes, drastically increasing extinction risks.

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130. (C) I and III only
Vegetative propagation allows plants to grow faster than raising them from seeds (statement I) and produces genetically uniform offspring (statement III). Statement II is incorrect because vegetative propagation is an asexual process that requires only a single parent plant, utilizing roots, stems, or leaves to generate new individuals.

131. (B) Unfavourable conditions like lack of water or extreme heat.
Spore formation in fungi like Rhizopus is typically triggered when environmental conditions become unfavourable, such as during severe water scarcity, nutrient depletion, or extreme temperatures. Encapsulating genetic material inside thick-walled spores allows the fungus

individuals better resistance to environmental stresses, such as heat or disease. This genetic diversity forms the foundation for natural selection and long-term species evolution.

70. (B) I and III only
Planaria can regenerate an entire organism from a small body piece (statement I) through the rapid proliferation and differentiation of specialized cells (statement III). Statement II is incorrect because regeneration is a injury-response repair process, not its primary mode of reproduction. Statement IV is wrong since Planaria is a simple invertebrate flatworm.

71. (B) Baking and brewing industries
Yeast rapidly metabolizes sugars through anaerobic respiration, producing carbon dioxide gas and ethanol. This property, combined with its rapid budding reproduction, is widely exploited in baking to make dough rise and in brewing to ferment sugar solutions into alcoholic beverages like beer and wine on an industrial scale.

72. (C) Lactobacillus
Lactobacillus is an economically crucial bacterium that reproduces rapidly through binary fission in warm milk. During its metabolic activity, it converts lactose sugar into lactic acid, which coagulates milk proteins to form curd. High rates of bacterial reproduction ensure efficient, rapid curdling of milk in dairy production processes.

73. (D) They are genetically identical to the parent.
Budding in Hydra is an asexual reproductive process driven by mitotic cell divisions at a localized site on the parent body. Because no gametic fusion or genetic recombination occurs, the resulting offspring receive an exact copy of the single parent's DNA, making them genetically identical to the parent individual.

74. (A) Low genetic variation means no traits may suit the new environment.
Asexually reproducing populations consist of genetically uniform individuals sharing identical traits and weaknesses. If environmental conditions change drastically, such as a sharp temperature increase or new disease, low genetic variation means all individuals may lack resistance, drastically increasing the likelihood that the entire population will be wiped out.

75. (C) DNA replication
Whether an organism reproduces sexually or asexually, the universal requirement at the cellular level is DNA replication. Before any cell divides or creates reproductive structures, it must duplicate its genetic material. This ensures that every resulting offspring receives a complete set of biological instructions required to govern growth and metabolism.

76. (B) Adventitious buds
In plants like Bryophyllum, vegetative propagation occurs via adventitious buds located in the notches along the leaf margins. These non-standard buds develop on vegetative organs rather than at stem nodes. When the leaf falls onto moist soil, these adventitious buds sprout roots and shoots to form complete new plantlets.

77. (D) Vegetative propagation
Seedless plant varieties like commercial bananas, pineapples, and seedless oranges cannot reproduce through seed germination or sexual crossing. Vegetative propagation utilizes vegetative parts like stem cuttings, runners, or suckers to reproduce these species asexually, allowing agricultural growers to produce uniform, high-yielding seedless crops while consistently preserving desirable plant traits.

78. (B) Upon reaching maturity, the organism simply breaks into pieces.
Spirogyra undergoes fragmentation as its natural mode of asexual reproduction. Upon reaching biological maturity, the simple multicellular filamentous body cleanly breaks apart into smaller fragments. Each separated piece continues to grow through simple mitotic cell divisions, eventually developing into an independent, mature Spirogyra filament without needing gametes.

79. (D) Inside a cyst, the nucleus divides repeatedly to form many small cells.
During multiple fission in Plasmodium, the single-celled organism encloses itself within a protective cyst. Inside this cyst, the parent nucleus divides repeatedly by mitosis to form numerous daughter nuclei. Cytoplasm subsequently gathers around each nucleus, splitting the parent cell into many small daughter cells that are released simultaneously.

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80. (A) II, III, IV, I
Biological hierarchy in single-celled organisms ranges from molecular to organismal levels. DNA is a nucleic acid molecule contained inside the membrane-bound nucleus. The nucleus forms a central organelle within the single cell, and that single cell constitutes the entire living organism. Thus, the correct structural order is II, III, IV, I.

81. (B) 10
Asexual reproduction relies on mitotic cell division, which is an equational division process. During mitosis, the single parent cell duplicates its genetic material before dividing, ensuring that each daughter cell receives a complete set of chromosomes. Therefore, if the parent has 10 chromosomes, the newly formed daughter cell will also have 10 chromosomes.

82. (B) The new cell lacks necessary genetic instructions to survive and function.
DNA holds the master chemical blueprint required for protein synthesis, cellular metabolism, and functional regulation. If DNA replication fails prior to cell division, the resulting daughter cell will receive incomplete or broken genetic material. Lacking necessary biological instructions, the newly formed cell cannot synthesize vital enzymes and will rapidly die.

83. (C) Mitosis
Vegetative propagation is an asexual mechanism where new plants develop from vegetative structures like roots, stems, or leaves. This process depends entirely on mitosis, which drives cell multiplication and tissue differentiation while preserving the parental chromosome number. Gametic fusion or meiotic reduction division does not take place during vegetative propagation.

84. (C) A pollen grain fertilising an ovule in a flower
A pollen grain fertilising an ovule represents sexual reproduction in flowering plants, as it involves the fusion of male and female haploid gametes to form a diploid zygote. Conversely, potato tuber sprouting, starfish regeneration, and yeast budding occur without gamete fusion, making them true modes of asexual reproduction.

85. (B) Nucleus
The nucleus is the primary membrane-bound organelle that stores the master genetic blueprint in eukaryotic cells. Within the nucleus, DNA is organized into thread-like chromosomes containing genes that direct protein synthesis and cellular functions. During cellular reproduction, this nuclear genetic material is replicated and distributed evenly to daughter cells.

86. (C) It is much shorter, allowing rapid population growth.
Bacteria have simple prokaryotic cellular structures and reproduce via straightforward binary fission without needing complex tissue differentiation or mate searching. Consequently, their generation time—the time required to divide—is significantly shorter than that of complex multicellular organisms, enabling bacterial populations to grow exponentially under favourable environmental conditions.

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87. (C) Under unfavourable environmental conditions
Amoeba secretes a tough, protective three-layered cyst around its body when faced with unfavourable environmental conditions, such as extreme temperatures, desiccation, or food scarcity. Encystment allows the protozoan to enter a dormant state, protecting its internal cellular machinery from environmental stress until favourable conditions eventually return.

88. (A) It undergoes multiple fission, producing minute amoebae.
When favourable environmental conditions return, the encysted Amoeba reactivates its metabolic processes and undergoes multiple fission inside the protective wall. The nucleus divides repeatedly to produce numerous tiny daughter nuclei, which acquire small cytoplasm portions. The cyst wall then ruptures, releasing many minute pseudopodiospores into the surrounding water.

89. (B) Pseudopodiospores
The minute daughter amoebae formed through multiple fission inside a cyst are technically termed pseudopodiospores. When the protective cyst ruptures upon the return of favourable conditions, these tiny unicellular bodies are released into the aquatic environment, where they feed, grow, and mature into independent adult Amoeba individuals.

90. (B) I and III
Spores are microscopic reproductive units that germinate into new individuals (statement I)

and feature thick, resistant walls to withstand harsh conditions, making statement III correct. Statement II is false because spores possess thick, protective walls rather than thin, delicate ones, enabling them to survive desiccation and temperature extremes.

91. (B) ATP
The metabolic energy needed for cell division, DNA replication, and organelle synthesis is supplied by Adenosine Triphosphate (ATP). ATP releases energy when its high-energy phosphate bonds are broken down by cellular enzymes, fueling the energetic costs of building new cytoplasmic components and dividing genetic material during reproduction.

92. (C) It reactivates metabolic processes needed for spore growth.
Fungal spores remain dormant inside thick protective walls during dry conditions. Moisture is essential for spore germination because water absorption hydrates the internal cytoplasm and reactivates cellular enzymes. This metabolic activation enables the spore to break open its outer wall, swell, and sprout a new fungal hypha.

93. (A) Yeast is unicellular while Hydra is multicellular.
A fundamental structural distinction between yeast and Hydra budding lies in cellular organization. Yeast is a microscopic, single-celled fungus where budding involves unequal cytoplasmic division of a single cell. In contrast, Hydra is a multicellular animal where budding involves localized cell proliferation and tissue differentiation across body cell layers.

94. (C) Certain plants, animals, and microorganisms
Asexual reproduction and regenerative capabilities from a single body part are present across diverse biological domains. Various plants (via vegetative propagation), simple animals like Hydra and Planaria (via budding and regeneration), and microorganisms like fungi and protozoans (via fission or spores) can successfully produce new individuals from isolated body parts.

95. (A) P-3, Q-4, R-1, S-2
Different plants utilize specific vegetative organs for propagation: potatoes develop new sprouts from swollen underground stem tubers (eyes), whereas sweet potatoes propagate via root tubers. Bryophyllum forms adventitious buds along its leaf margins, and rose plants are routinely multiplied in horticulture through artificial stem cuttings.

96. (C) DNA
Deoxyribonucleic acid, commonly known as DNA, is the master biological molecule responsible for carrying hereditary information from parent cells to offspring. Sequences of nucleotides in DNA store the genetic code for producing functional cellular proteins. During cellular division, DNA replicates to ensure identical genetic instructions are transmitted to daughter cells.

97. (B) All three pieces regenerate into complete Planaria.
Planaria possesses remarkable regenerative capabilities due to specialized stem-like cells distributed throughout its body. If a single flatworm is cut into head, middle, and tail pieces, each fragment proliferates new tissue and differentiates missing organs, resulting in three complete, fully functional Planaria individuals from the original single worm.

98. (B) Continual reproduction
Because individual living organisms inevitably succumb to natural aging, environmental hazards, or predation, continuous reproduction is necessary to prevent species extinction. By producing new offspring across successive generations, reproduction continuously replaces dying individuals and preserves genetic lineages, ensuring the long-term survival and stability of the species over time.

99. (B) Their body design is simple, lacking specialized tissues.
Spirogyra is a simple multicellular green alga whose filamentous structure consists of similar cells arranged end-to-end without true tissues or complex organs. Because each constituent cell retains full division potential and metabolic self-sufficiency, the organism can easily reproduce through simple fragmentation without requiring elaborate tissue differentiation mechanisms.

100. (A) The cytoplasm constricts and divides.
During binary fission in single-celled organisms, nuclear division (karyokinesis) is immediately followed by cytoplasmic division (cytokinesis). A constriction or cleavage furrow forms along the cellular membrane, deepening inward until

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constricts symmetrically to divide into two equal daughter cells.

142. (C) Artificial vegetative propagation (cutting)
Planting a severed stem piece from a rose plant to grow a new individual is a classic example of artificial vegetative propagation known as stem cutting. The isolated stem section contains vegetative nodes with dormant buds that sprout adventitious roots and shoots when planted in soil, yielding a genetically identical rose.

143. (B) It divides in a longitudinal plane due to flagellum orientation.
Unlike Amoeba, which lacks a fixed body shape and can split across any arbitrary plane, Leishmania possesses a defined, elongated body with a whip-like flagellum at one end. Due to this specific structural arrangement, binary fission in Leishmania occurs exclusively along a definite longitudinal plane aligned with its flagellum.

144. (C) Multiple pieces regenerate into complete individual Planaria.
When a Planaria flatworm is cut or crushed into multiple fragments, each isolated piece can regenerate into a complete new worm. Specialized stem cells called neoblasts proliferate rapidly at the injury sites and differentiate into all missing body tissues, organs, and head structures, resulting in multiple fully functional individuals.

145. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Plants raised through vegetative propagation bear flowers and fruits much earlier than seed-grown plants because they bypass the slow processes of seed germination, seedling establishment, and juvenile development. Utilizing mature vegetative tissues enables the new plant to maintain advanced developmental maturity, validating both the assertion and its explanation.

146. (B) Leaves with marginal buds
Bryophyllum reproduces vegetatively through specialized adventitious buds situated along the notches of its fleshy leaf margins. When mature leaves detach from the parent plant and fall onto moist soil, these marginal buds sprout adventitious roots and small shoots, developing into independent plantlets that eventually grow into mature Bryophyllum plants.

147. (B) They carry the DNA blueprint from parents to offspring.
Chromosomes are thread-like structures located inside the cell nucleus, composed of DNA and proteins. They serve as the primary vehicles for biological inheritance, carrying genes that contain genetic instructions. During cell division, duplicated chromosomes are distributed to daughter cells, ensuring the accurate transmission of traits from parents to offspring.

148. (A) Yeast
Yeast is a microscopic single-celled fungus that reproduces primarily through asymmetric cellular budding under favourable conditions, rather than forming asexual spores inside sporangia. In contrast, filamentous fungal species like Rhizopus, Mucor, and Penicillium regularly produce large quantities of microscopic spores inside specialized sporangial structures for reproduction.

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149. (B) Perpetuate the species
The primary biological purpose of reproduction is to perpetuate the species across successive generations. Because individual living organisms inevitably experience biological aging, disease, and death, reproduction ensures that new offspring are continuously produced, replacing dying individuals and preventing population collapse to maintain species survival over long periods.

150. (A) I, II and III
Paramecium is a single-celled protozoan (statement I) that typically reproduces asexually through transverse binary fission (statement II). It can also exchange genetic material via conjugation (statement III), which represents a primitive sexual process. Statement IV is incorrect because Paramecium does not reproduce by fragmentation, which is characteristic of multicellular algae.

151. (B) Spores form asexually in organisms like Rhizopus; seeds form sexually.
A fundamental difference between a spore and a seed lies in their mode of origin. Spores in organisms like Rhizopus are single-celled or microscopic asexual structures formed without gametic fusion. In contrast, seeds are complex multicellular plant structures containing an embryo produced sexually through pollination and double fertilisation.

abundant organic nutrients. Supplying a warm, sugar-rich growth medium provides yeast cells with the chemical energy and carbon skeletons needed to accelerate nuclear division and bud formation, serving as the most effective method to rapidly multiply yeast cultures.

112. (B) Reproduction is the primary process adding new members to a population.
Population growth is directly determined by the rate at which new organisms are generated relative to the mortality rate. Reproduction is the fundamental biological process that adds new individuals to a population. Higher reproduction rates result in faster additions, leading directly to rapid population expansion under suitable conditions.

113. (B) Both grow a complete organism from a separated part.
Fragmentation and regeneration share the fundamental biological feature of growing a complete, fully functional organism from a detached or cut body segment. In both processes, separated body pieces undergo continuous mitotic cell divisions and tissue differentiation to reconstruct missing organs, producing viable new individuals without involving gamete fusion.

114. (B) The lack of genetic diversity.
Asexual reproduction generates offspring that are exact genetic copies of the single parent. Because the population lacks genetic diversity, all individuals share identical traits and vulnerabilities. If environmental conditions alter rapidly, such as a temperature shift or pathogen introduction, the entire population may fail to adapt and face extinction.

115. (B) Amoeba
Amoeba clearly demonstrates that reproduction in unicellular organisms is directly synonymous with cell division. When an individual Amoeba undergoes mitotic binary fission, the division of its single cell produces two independent daughter organisms. Thus, for single-celled protozoans, the process of cell division is itself the act of reproduction.

116. (C) Fertilisation
Fertilisation is the biological fusion of male and female haploid gametes to form a diploid zygote, serving as the defining feature of sexual reproduction. Conversely, budding, binary fission, and fragmentation are strictly asexual reproductive methods where new offspring develop from a single parent without gamete production or nuclear fusion.

117. (B) Mouth and tentacles
During budding in Hydra, localized cell proliferation forms an outgrowth that gradually differentiates into a miniature animal. Before detaching from the parent body to live independently, the young bud must develop essential feeding structures, specifically a mouth surrounded by tentacles, ensuring it can capture food and survive autonomously.

118. (D) Multiple fission yields many cells at once; binary yields two.
Binary fission and multiple fission differ primarily in the number of offspring produced in a single division cycle. Binary fission involves a single nuclear division followed by cytoplasm splitting into two daughter cells. Multiple fission involves repeated nuclear divisions within a protective cyst, generating numerous daughter cells simultaneously upon release.

119. (B) Genetically identical to the parent plant
Vegetative propagation is an asexual mode of multiplication in plants that bypasses gamete formation and seed production. Because new plants develop via mitosis from vegetative organs like roots, stems, or leaves, the offspring inherit an exact copy of parental DNA, making them genetically identical to the parent plant.

120. (A) Body is cut → Specialised cells proliferate → Cells differentiate into various tissues
Regeneration in Planaria proceeds through a distinct sequence of biological steps. First, physical damage or cutting separates a body piece. Next, specialized regenerative cells at the cut site proliferate rapidly, forming a cell mass. Finally, these cells differentiate into distinct tissue types and organs, completing the whole worm.

121. (A) Acting as primary decomposers and nutrient recyclers
Rapid asexual reproduction enables unicellular microorganisms, such as bacteria and fungi, to quickly build large population densities. In natural ecosystems, these abundant microbes act as primary decomposers, breaking down dead organic material and recycling essential nutrients

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the cytoplasm divides completely, splitting the parent cell into two independent daughter cells containing their respective nuclei.

101. (D) It produces a high degree of genetic variation.
Asexual reproduction involves a single parent generating offspring through mitosis without gametic fusion. While it allows for rapid multiplication, saves energy, and requires no mate, it produces genetically uniform clones. The absence of high genetic variation is a distinct biological limitation rather than an advantage of asexual reproduction.

102. (D) Bud
In Hydra, localized cell division occurs continuously at a specific site on the body wall, driven by specialized regenerative cells. This repeated proliferation produces a visible cellular bump or outgrowth known as a bud, which gradually differentiates to form a young Hydra complete with a mouth and tentacles.

103. (B) Copies are similar, but biochemical variations prevent absolute identity.
DNA replication during asexual reproduction is highly precise but relies on enzymatic reactions that are not completely foolproof. Subtle biochemical inaccuracies occur during nucleotide assembly, introducing minor variations into the copy. Consequently, while the duplicated DNA strands are highly similar to the parent molecule, they are not always 100% identical.

104. (B) A clone of the parent cell
Bacteria reproduce asexually through binary fission, duplicating their circular DNA before splitting into two daughter cells. Because this division proceeds without gametic fusion or genetic crossing-over, the resulting offspring possess genetic material virtually identical to the parent bacterium, making the new cell a clone of its parent.

105. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Vegetative propagation is classified as an asexual reproductive method because it produces new plants from non-reproductive structures like roots, stems, or leaves without involving flowers, gametes, or fertilization. Since gamete formation and fusion are completely absent, vegetative propagation is strictly non-sexual, validating both the assertion and its explanation.

106. (A) It allows easy nutrient absorption needed for energy during division.
Because a single-celled organism has its entire cell surface exposed directly to the external environment, it can efficiently absorb dissolved nutrients and oxygen via simple diffusion. These absorbed resources supply the chemical metabolic energy required for organelle duplication, nuclear division, and cytokinesis during the asexual reproduction process.

107. (D) Generation time
Generation time, also known as doubling time, is the time required for a population of unicellular organisms to double in number through cell division. In bacteria, it represents the exact duration between consecutive binary fission events, reflecting how rapidly a bacterial strain can multiply under given environmental conditions.

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108. (C) Cellular reproduction
DNA replication is a fundamental prerequisite for cellular reproduction in all living organisms. Before a cell divides to form new individuals or tissues, it must construct an exact copy of its genetic material. This ensures that every resulting cell receives a complete genome to direct cellular functions.

109. (B) Thick protective walls
Spores produced by the bread mould Rhizopus are enclosed within thick, durable protective walls. This structural adaptation shields the delicate internal nucleus and cytoplasm from environmental hazards like dry air and high temperatures, allowing the spores to remain viable while floating through the atmosphere until finding moist substrate.

110. (B) I, II and III
In unicellular organisms, cell division occurs via mitosis (statement I) to produce complete new individuals (statement II), involving accurate replication and separation of copied DNA (statement III). Statement IV is incorrect because free-living single-celled organisms like Amoeba and Paramecium undergo cell division independently without needing a host cell.

111. (B) Providing a warm, nutrient sugar solution to promote budding.
Yeast reproduces asexually through rapid budding when provided with optimal temperature and

to enter a dormant state, enabling long-term survival through harsh conditions until moisture and nutrients return.

132. (A) Reproduces asexually via cell division
The fundamental distinction in reproduction between a single-celled bacterium and a human lies in the underlying mechanism. A bacterium reproduces asexually through simple cell division (binary fission), where one cell becomes two individuals. In contrast, humans rely on complex sexual reproduction involving specialized gametes, fertilization, and tissue development.

133. (D) Chain of buds forming one after another
Under highly favourable conditions rich in organic nutrients, yeast cells reproduce extremely rapidly through asexual budding. Because nuclear division and bud growth occur faster than the time required for complete detachment, newly formed buds produce secondary buds, resulting in a continuous chain of attached yeast cells under observation.

134. (A) Every cell in the fragment can divide and grow.
Spirogyra possesses a simple filamentous structure where individual cells are uniform and non-specialized. Consequently, when a filament breaks into smaller pieces during fragmentation, every constituent cell within a fragment retains full metabolic capabilities and the ability to undergo repeated mitotic divisions, allowing the fragment to grow into a full filament.

135. (A) P-3, Q-1, R-2, S-4
Clones are genetically identical organisms produced from a single parent through asexual reproduction. A cyst is a protective wall formed during unfavourable environmental conditions. A spore is a microscopic reproductive unit featuring thick walls for dispersal, and a bud represents a small body outgrowth that develops into a new individual.

136. (B) An individual can live its entire life without reproducing.
Unlike essential physiological processes like respiration, nutrition, and excretion—which are continuously required to maintain cellular homeostasis and keep an individual organism alive—reproduction is not necessary for individual survival. An organism can live a complete lifespan without ever reproducing, though reproduction remains essential for species continuity.

137. (B) Malaria
Malaria is a parasitic disease caused by the single-celled protozoan Plasmodium. This organism reproduces asexually through multiple fission within human liver cells and red blood cells. Inside a protective cyst or host cell, the nucleus divides repeatedly, producing dozens of daughter merozoites that break out simultaneously to spread infection.

138. (A) In Amoeba it creates an organism; in skin cells it repairs tissue.
In the single-celled protozoan Amoeba, mitotic division of the cell directly generates two complete, independent offspring, making mitosis equivalent to asexual reproduction. In contrast, in multicellular humans, mitotic division of skin cells serves to replace worn-out cells, repair damaged tissue, and maintain skin integrity without creating new individual organisms.

139. (C) It allows for rapid and exponential expansion.
In suitable environments with abundant nutrients and optimal ambient temperatures, asexual reproduction enables rapid and exponential population expansion. Because organisms do not expend metabolic energy finding mates or producing gametes, single-celled microbes and simple organisms can divide rapidly and continuously, leading to swift increases in total population numbers.

140. (A) I, IV, III, II
Spore formation and germination in Rhizopus follows a distinct sequence. First, vegetative hyphae develop upright sporangia at their tips. Next, nuclear divisions occur inside the sporangium to form spores. The sporangium then ruptures, releasing spores into the air. Finally, airborne spores land on moist surfaces and germinate into new hyphae.

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141. (C) Yeast forms a small bud; Amoeba divides into equal halves.
The primary difference in asexual reproduction between yeast and Amoeba lies in the symmetry of division. Yeast undergoes budding, where cytoplasm divides unequally to form a small external bud on the parent cell. Amoeba undergoes binary fission, where the parent cell

nuclei during karyokinesis. Simultaneously, a visible constriction or furrow forms in the middle of the cytoplasm, deepening until the cell splits cleanly.

60. (A) Higher reproduction rates drive rapid growth in favourable conditions.
The rate of reproduction directly governs the speed at which new individuals are added to a population. When environmental conditions, food availability, and temperatures are optimal, high reproduction rates lead to rapid population growth. This exponential increase allows species to quickly maximize resource utilization within their specific ecological niches.

61. (B) In unicellular forms it is reproduction; in multicellular forms it is growth and repair.
In single-celled organisms, mitotic division creates a whole new independent organism, making mitosis synonymous with asexual reproduction. In contrast, complex multicellular organisms use mitosis primarily to increase total cell numbers during body growth, replace worn-out tissues, and repair damaged structures, while relying on specialized gametic mechanisms for reproduction.

62. (D) The entire cytoplasm and its contained organelles
Following nuclear division during binary fission, the entire cytoplasm along with its suspended organelles must divide equally during cytokinesis. Structures such as mitochondria, ribosomes, and vacuoles are distributed between the two emerging cells, ensuring both daughter units possess complete cellular apparatus required to support independent metabolic functions.

63. (A) Sporangia at the tips of hyphae
During its reproductive phase, the fungus Rhizopus produces specialized upright hyphae topped with round, blob-like structures called sporangia. These sporangia are filled with microscopic spores that serve as asexual reproductive units. Upon maturation, the sporangial walls rupture, releasing spores into the surrounding air to establish new fungal growths.

64. (D) Yeast buds formed sequentially without detaching from the parent.
Under optimal nutrient conditions, yeast cells undergo rapid asexual budding. When cellular division is exceptionally fast, new buds begin forming on existing daughter buds before they separate from the parent cell. This sequence of continuous budding creates temporary chains of interconnected yeast cells visible under microscopic observation.

65. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Amoeba can divide along any arbitrary plane during binary fission because it lacks a rigid cell wall, fixed body axis, or specialized external structures like flagella. Its body shape is completely irregular and constantly changing, allowing nuclear and cytoplasmic division to occur cleanly in any orientation across the cell.

66. (D) Asexual reproduction
Asexual reproduction involves cell division through mitosis without the fusion of gametes, crossing-over, or independent assortment of chromosomes. Because offspring inherit an exact copy of the single parent's DNA, this reproductive process maintains genetic uniformity across generations and does not generate significant genetic variation among the resulting offspring.

67. (C) Reproduce and generate new individuals
While individual organisms eventually age and die, a species survives over long evolutionary periods through reproduction. By continuously generating new offspring to replace dying individuals, reproduction ensures genetic continuity across generations. Without this process, a species population would diminish over time, leading directly to eventual biological extinction.

68. (D) It loses identity by dividing into two daughter cells.
During binary fission in Amoeba, the entire parent organism undergoes nuclear and cytoplasmic division, splitting into two distinct daughter cells. Because the original cellular structure is divided equally to form the new individuals, the single parent cell no longer exists as a separate entity, thereby losing its individual identity.

69. (B) It forms the basis for evolution and species survival during changes.
Minor variations arising during DNA replication provide essential genetic diversity within a population. Even in asexually reproducing species, small variations may grant certain

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152. (B) It is lost when the parent splits into two new individuals.
During binary fission, the single parent cell splits completely into two daughter cells during cytokinesis. Because the entire cytoplasm and nuclear material of the parent are divided to construct the new individuals, the original parent cell ceases to exist as a separate entity, thereby losing its distinct individual identity.

153. (B) Vegetative propagation
Plant tissue culture, or micropropagation, involves growing new plants from small tissue samples placed in a sterile, nutrient-rich growth medium. Because it produces complete, genetically uniform plants from somatic vegetative cells without involving gametes or seeds, tissue culture represents an advanced, highly controlled artificial application of vegetative propagation.

154. (C) Decrease drastically or stop
Budding in yeast is a metabolically active process that requires moisture and an energy substrate like sugar for cellular respiration and macromolecular synthesis. If yeast is kept in a completely dry container without sugar, cellular metabolism slows down significantly, causing the rate of budding to decrease drastically or stop entirely.

155. (A) They change cell types in an organised sequence.
Regeneration in Planaria is an organized biological process. Following body cutting, specialized regenerative cells proliferate at the wound site to form a blastema. These unspecialized cells then undergo precise, sequential differentiation into various specific cell types, correctly forming missing tissues, nerves, and organs in a highly ordered manner.

156. (C) 8
Binary fission results in an exponential population doubling during each division round according to the formula 2 raised to the power of n, where n represents the number of division rounds. Starting with 1 Amoeba, round one yields 2, round two yields 4, and after 3 rounds, exactly 8 Amoebae exist.

157. (B) It forms a cyst and undergoes repeated nuclear divisions.
Multiple fission is distinguished from other asexual reproduction methods by encystment and repeated nuclear division. Under stressful conditions, the parent cell forms a protective cyst wall, inside which the single nucleus divides repeatedly by mitosis into numerous daughter nuclei, eventually releasing many daughter cells simultaneously when the cyst ruptures.

158. (B) Non-reproductive vegetative structures
The white, thread-like structures of Rhizopus that branch across bread slices are vegetative hyphae. These hyphae form a network called the mycelium, which anchors the fungus and secretes digestive enzymes to absorb nutrients. They do not produce spores directly and represent non-reproductive vegetative structures rather than specialized reproductive organs.

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159. (B) Amoeba divides as a single cell; dogs require two parents and gametes.
Amoeba reproduces asexually as a single cell through simple binary fission, splitting into two identical daughter cells without needing a mate. In contrast, dogs reproduce sexually, requiring two distinct parents of opposite sexes to produce haploid gametes (sperm and egg) that fuse during fertilization to form a genetically unique offspring.

160. (A) DNA replicates → Nucleus divides → Cytoplasm divides
Asexual cell division in a unicellular organism proceeds through a strict biological sequence. First, the parent cell duplicates its genetic material during DNA replication. Next, the cell undergoes karyokinesis, where the nucleus divides into two daughter nuclei. Finally, cytokinesis occurs, constricting and dividing the cytoplasm to form two separate cells.

161. (C) Asexual reproduction
A clone is defined as a group of genetically identical organisms derived from a single parent individual. Because asexual reproduction operates through mitotic division without the involvement of gamete fusion or genetic recombination, all newly produced offspring inherit identical DNA sequences, forming a population of genetically identical clones.

162. (A) DNA requires cellular machinery to function and survive in new cells.
Replicated DNA cannot survive or direct biochemical activities on its own without cellular machinery. The creation of an additional cellular

(D) To function as the primary physical site for oxygen and waste gas exchange

46. The common passage for both urine and sperm in human males is the:
(A) Vas deferens
(B) Ureter
(C) Seminal vesicle
(D) Urethra

47. Why are young adolescents often counselled about reproductive health?
(A) To prepare young individuals for early and voluntary surgical sterilization procedures
(B) To educate them on bodily changes, hygiene, and safe practices
(C) To actively promote childbearing prior to achieving full physical and emotional maturity
(D) To replace standard general school curricula entirely with specialized clinical medical training

48. During early embryonic development, the zygote undergoes repeated divisions to form a hollow ball of cells. This process of division is known as:
(A) Cleavage
(B) Meiosis
(C) Fertilisation
(D) Parturition

49. Which of the following correctly describes a major difference between sexual and asexual reproduction?
(A) Asexual reproduction always requires two parents.
(B) Sexual reproduction produces offspring that are exact clones.
(C) Sexual reproduction leads to greater genetic variation.
(D) Asexual reproduction is impossible in multicellular organisms.

50. Match the contraceptive method in List I with its category in List II.
List I: Contraceptive Method
P. Condom
Q. Copper-T
R. Oral Pill
S. Vasectomy
List II: Category
1. Hormonal method
2. Surgical method
3. Intrauterine device
4. Barrier method
(A) P-4, Q-3, R-1, S-2
(B) P-3, Q-4, R-1, S-2
(C) P-4, Q-1, R-3, S-2
(D) P-1, Q-2, R-3, S-4

51. The period during adolescence when reproductive organs become functional is called:
(A) Gestation
(B) Senescence
(C) Menopause
(D) Puberty

52. Which secondary sexual characteristic is common to both males and females during puberty?
(A) Pronounced growth of thick facial coarse hair and beard tissue
(B) Growth of body hair in axillary and pubic areas
(C) Distinct structural broadening of the pelvic bones and hip region
(D) Noticeable deepening of the vocal range down to a much lower pitch

53. The seminal vesicles and prostate gland contribute to the formation of:
(A) Urine
(B) Blood
(C) Semen
(D) Lymph

54. The process of gametogenesis in human females begins:
(A) Immediately at the exact moment of birth
(B) During fetal development
(C) Upon reaching the onset of biological puberty
(D) Exclusively following the completion of a first pregnancy

55. Consider the following statements regarding the female reproductive system:
I. The ovaries produce thousands of new immature eggs every month after puberty.
II. One egg is typically released every month by one of the ovaries.
III. The fallopian tube is the passage that carries the egg from the ovary to the uterus.
Which of the above statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

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automatically when the alga reaches biological maturity. In contrast, regeneration is primarily a tissue-repair mechanism triggered when an organism suffers accidental cutting or physical damage.

173. (B) To coordinate division and distribute replicated genetic material.
During binary fission, the cell nucleus serves as the command center for genetic duplication and distribution. It coordinates DNA replication prior to division and undergoes karyokinesis to split the duplicated genome equally into two daughter nuclei. This precise process guarantees that each emerging cell receives identical genetic instructions.

174. (C) Chromosomes
Chromosomes are nuclear structures composed of tightly coiled DNA that store hereditary information. During asexual reproduction, chromosomes undergo exact replication and equal division between emerging daughter cells via mitosis. This precise distribution maintains genetic continuity across generations, ensuring single-celled organisms reliably transmit identical biological traits to offspring.

175. (A) P-2, Q-1, R-4, S-3
Amoeba undergoes binary fission in any arbitrary plane due to its irregular body shape. Leishmania divides strictly along a definite longitudinal plane relative to its flagellum. Yeast produces unequal external buds during rapid multiplication, and Rhizopus forms specialized sporangia containing microscopic asexual spores at the tips of hyphae.

176. (C) It decreases drastically or stops.
Binary fission in bacteria relies heavily on enzyme activity and metabolic chemical energy. Transferring bacteria from a warm, nutrient-rich environment to freezing conditions without nutrients severely inhibits metabolic enzymes and starves cells of energy, causing the rate of binary fission to decrease drastically or halt completely.

177. (C) Simple multicellular, filamentous design lacking tissue differentiation.
Spirogyra possesses a simple multicellular, filamentous body design consisting of a chain of similar cells without true tissues or specialized organs. Because every cell retains metabolic self-sufficiency and full division capabilities, the filament can easily break into fragments, each growing into a complete filament through simple cell division.

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178. (C) Specialised regenerative cells
Regeneration in Hydra depends on specialized stem-like regenerative cells present within its body tissues. When the body is injured or severed, these specialized cells undergo rapid mitotic proliferation, forming a mass of cells that subsequently differentiate into distinct cell types, successfully reconstructing all missing tentacles and body parts.

179. (B) They will likely all die, sharing the same genetic vulnerability.
In a population of cloned bacteria derived from a single parent through binary fission, all individuals possess identical genetic material. Because no genetic variation exists, if the parent strain is susceptible to a lethal antibiotic, every single cloned bacterium shares that exact vulnerability, resulting in the complete destruction of the population.

180. (A) II, IV, I, III
Budding in Hydra follows a structured sequence. First, repeated cell divisions at a specific location create an outgrowth (II). Next, this outgrowth increases in physical size (IV). The developing bud then differentiates to form a mouth surrounded by tentacles (I). Finally, the fully developed young Hydra detaches to live independently (III).

181. (B) Mammals have highly organised organ systems, not simple cell clusters.
Mammals possess complex body organization with specialized tissues arranged into distinct organ systems like nervous, circulatory, and digestive systems. Unlike simple multicellular algae or flatworms, mammalian somatic cells are highly differentiated and cannot spontaneously re-organize or revert to stem-like states to regenerate a complete organism from a severed body fragment.

182. (B) Division of the cytoplasm
During cell division, cytokinesis refers specifically to the division of the cytoplasm following nuclear division (karyokinesis). A cleavage furrow or cell plate forms in the middle of the cell, deepening until the cytoplasmic contents and organelles

(C) Parturition
(D) Spermatogenesis

23. Childbirth (parturition) occurs primarily due to which of the following mechanisms?
(A) Relaxation of the abdominal muscles
(B) Expansion of the fallopian tubes
(C) Sudden detachment of the placenta before labour begins
(D) Rhythmic contractions of the muscles in the uterus

24. Which of the following is considered a barrier method of contraception?
(A) Condoms
(B) Oral contraceptive pills
(C) Copper-T
(D) Vasectomy

25. Consider the following statements regarding contraceptive methods:
I. Copper-T is placed in the uterus to prevent pregnancy.
II. Oral pills work by changing the hormonal balance to prevent egg release.
III. Surgical methods block gamete transport completely.
IV. Condoms provide no protection against sexually transmitted diseases.
Which of the above statements is/are correct?
(A) I, II and IV only
(B) I, II and III only
(C) II, III and IV only
(D) I, III and IV only

26. How do oral contraceptive pills prevent pregnancy?
(A) They form a continuous physical barrier preventing sperm from meeting the egg
(B) They release chemicals that instantly destroy sperm upon entering the vagina
(C) They alter hormonal balances to prevent egg release
(D) They cause permanent physical blockages within the fallopian tubes

27. What is the surgical method of contraception in human males called?
(A) Tubectomy
(B) Ovariectomy
(C) Hysterectomy
(D) Vasectomy

28. In a tubectomy, which part of the female reproductive system is blocked?
(A) Fallopian tube
(B) Uterus
(C) Vagina
(D) Cervix

29. Which of the following sexually transmitted diseases is caused by a virus?
(A) Gonorrhoea
(B) Syphilis
(C) Cholera
(D) HIV-AIDS

30. Which of the following sexually transmitted diseases is caused by bacteria?
(A) Warts
(B) Syphilis
(C) HIV-AIDS
(D) Hepatitis B

31. What is the primary purpose of family planning measures?
(A) To significantly increase the overall frequency of multiple pregnancies
(B) To permanently stop sexual reproduction across all human populations
(C) To regulate child spacing and control population growth
(D) To strictly enforce and promote surgical contraceptive procedures

32. What does IVF stand for in the context of assisted reproductive technology?
(A) Internal Vaginal Fertilisation
(B) In Vivo Fertilisation
(C) Induced Viral Fertilisation
(D) In Vitro Fertilisation

33. In the IVF procedure, where does the fertilisation of the egg by the sperm typically occur?
(A) In a laboratory dish outside the body
(B) Within the upper segment of the female's fallopian tube
(C) Directly within the muscular lining of the female's uterus
(D) Within the secretory ducts of the male's seminal vesicle

34. Why is prenatal sex determination legally banned in India?
(A) Because the underlying diagnostic procedure inflicts severe physical trauma on the foetus
(B) To prevent female foeticide and maintain a healthy sex ratio
(C) Because these diagnostic techniques yield inaccurate results that regularly mislead

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193. (B) The splitting of a parent cell into two daughter cells.
In biological terminology, the term 'binary' means consisting of two parts, whereas 'fission' refers to splitting apart. Therefore, binary fission literally describes an asexual reproductive process where a single single-celled parent organism undergoes complete nuclear and cytoplasmic division to split cleanly into exactly two equal daughter cells.

194. (B) Binary fission
Binary fission is regarded as the simplest and most primitive form of reproduction among single-celled organisms like bacteria and protozoans. It requires no complex tissue structures, specialized spores, or multicellular outgrowths. The cell simply duplicates its genetic material and divides into two equal parts to create new individuals.

195. (B) The root, stem, or leaves
While sexual reproduction in flowering plants takes place inside floral structures like stamens and pistils to generate seeds, vegetative propagation bypasses flowers completely. Instead, vegetative propagation relies on non-reproductive somatic plant organs—specifically roots, stems, or leaves—to generate complete new plantlets that are genetically identical to the parent plant.

196. (B) A high reproduction rate using asexual means.
Organisms adapted to a stable, unchanging environment benefit from multiplying rapidly through asexual reproduction. Because parental traits are already optimized for survival in that specific habitat, asexual reproduction allows organisms to reproduce quickly without wasting energy on mate location or producing variable offspring that might be less adapted.

197. (C) Paramecium
Paramecium is a ciliated unicellular protozoan that routinely multiplies asexually through transverse binary fission under favourable conditions. However, when exposed to environmental stress or physiological aging, it can also undergo conjugation, a primitive sexual mechanism where two cells temporarily unite to exchange nuclear genetic material, restoring population vigor.

198. (B) Asexual reproduction
In single-celled organisms, mitotic cell division represents the fundamental mechanism of asexual reproduction. Because the entire organism consists of a single cell, duplicating its nuclear DNA and splitting its cytoplasm yields two independent individuals. Thus, mitosis in unicellular organisms functions directly to generate new offspring rather than tissue growth.

199. (C) Yeast buds are single cells from unequal division; Hydra buds are multicellular.
The key structural difference between early buds in yeast and Hydra lies in cellular organization. A yeast bud is a single cell formed by unequal division of cytoplasm from a unicellular parent. In contrast, a Hydra bud is a complex multicellular outgrowth composed of multiple specialized cell layers.

200. (B) It enables rapid population growth but lacks variation for adapting.
Asexual reproduction acts as a double-edged sword for species survival. On one hand, it allows organisms to multiply rapidly and colonize habitats efficiently without expending energy to find mates. On the other hand, producing genetically identical clones leaves the entire population lacking variation, making them highly vulnerable to sudden environmental changes.

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apparatus—including cytoplasm, membranes, and organelle systems—provides the structural environment, enzymes, and metabolic components necessary for the new DNA copy to synthesize proteins and maintain life in the daughter cell.

163. (B) Vegetative propagation
Sugarcane is commercially cultivated using stem cuttings, which represents a classic form of vegetative propagation. Stem pieces containing healthy vegetative nodes and dormant buds are planted in soil. When watered, these buds sprout roots and stems, developing into complete new sugarcane plants genetically identical to the parent crop.

164. (C) Spores disperse into the air to germinate on moist surfaces.
When the outer wall of a mature Rhizopus sporangium ruptures, hundreds of microscopic, dust-like spores are released into the surrounding air currents. These lightweight airborne spores float until landing on a suitable, moist organic surface like bread, where they absorb water and germinate to form new fungal hyphae.

165. (B) Division of the nucleus
Karyokinesis specifically defines the biological process of nuclear division during cellular reproduction. During karyokinesis, the duplicated nuclear chromosomes condense, align, and separate equally into two daughter nuclei. This precise nuclear division precedes cytokinesis, ensuring both emerging cells receive a complete set of genetic instructions required for survival.

166. (B) Mitosis
Mitosis is the form of cell division predominantly associated with asexual reproduction. It produces two daughter cells containing chromosome numbers identical to the parent cell. Because mitosis duplicates genetic material equational without meiotic reduction or genetic crossing-over, it preserves genetic uniformity across generations in asexually reproducing organisms.

167. (B) A new disease or environmental change could wipe out identical populations.
Limited genetic diversity resulting from asexual reproduction leaves a population uniform in its biological traits and physiological weaknesses. If a novel disease, toxic chemical, or sudden climate shift impacts the habitat, all individuals share identical genetic vulnerabilities, significantly increasing the likelihood that the entire population could be wiped out.

168. (B) It requires ATP energy to synthesize macromolecules and cell structures.
Cellular reproduction is an energy-intensive biological process that relies directly on Adenosine Triphosphate (ATP). ATP supplies the chemical energy required for DNA replication, enzyme synthesis, membrane assembly, and cytoplasmic division. Consequently, the rate of reproduction is constrained by cellular energy production and nutrient availability required to sustain division.

169. (B) It rapidly produces large numbers of identical microbes for fermentation.
Industrial microbiology relies on the rapid asexual reproduction of yeast via budding to ferment sugars efficiently. Budding allows industrial facilities to quickly generate vast, genetically uniform microbial populations. These identical yeast cells maintain consistent metabolic efficiency, ensuring predictable fermentation rates during the production of bread, bioethanol, and alcoholic beverages.

170. (D) I, II and III
DNA contains hereditary information passed across generations (statement I) and serves as the template for RNA and protein synthesis (statement II). Changes in DNA sequences alter the primary structure of synthesized proteins (statement III). Therefore, all three statements accurately describe the fundamental biological role of DNA in inheritance and function.

171. (C) Purely asexual reproduction
An organism that continuously yields completely identical offspring over many generations without introducing genetic variation relies on purely asexual reproduction. Asexual multiplication operates through equational mitotic cell division without gametic fusion, chromosomal crossing-over, or independent assortment, consistently preserving exact parental genetic traits across successive generations.

172. (B) Fragmentation occurs at maturity; regeneration often needs accidental injury.
A key distinction between fragmentation in Spirogyra and regeneration in Planaria involves its natural timing. Fragmentation is a regular, natural reproductive process that occurs

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1. Transport of sperm
2. Site of fertilisation
3. Production of eggs
4. Production of sperm

(A) P-3, Q-4, R-1, S-2
(B) P-4, Q-3, R-2, S-1
(C) P-3, Q-4, R-2, S-1
(D) P-2, Q-1, R-4, S-3

11. Which hormone is primarily responsible for the development of secondary sexual characteristics in human males?
(A) Oestrogen
(B) Testosterone
(C) Progesterone
(D) Adrenaline

12. Which of the following changes is commonly observed in human males during puberty?
(A) Significant broadening of the hip bones and pelvic region
(B) Pronounced development of glandular breast tissues
(C) Cracking of the voice and growth of facial hair
(D) Onset of regular monthly menstrual cycles and bleeding

13. Which hormones are predominantly produced by the human ovaries?
(A) Testosterone and thyroxine
(B) Insulin and glucagon
(C) Growth hormone and adrenaline
(D) Oestrogen and progesterone

14. What is the term for the first occurrence of menstruation in a female at puberty?
(A) Menarche
(B) Menopause
(C) Ovulation
(D) Implantation

15. Consider the following statements regarding fertilisation in humans:
I. It is the fusion of a male gamete with a female gamete.
II. It takes place in the vagina of the female reproductive tract.
III. It results in the formation of a diploid zygote.
Which of the above statements is/are correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

16. What is the single cell formed immediately after the fusion of sperm and egg called?
(A) Embryo
(B) Foetus
(C) Zygote
(D) Blastocyst

17. The process by which the embryo becomes attached to the thickened lining of the uterus is known as:
(A) Fertilisation
(B) Implantation
(C) Ovulation
(D) Parturition

18. What is the placenta?
(A) A protective fluid-filled sac that surrounds and cushions the growing embryo
(B) A temporary gland that secretes essential hormones to trigger labor
(C) The heavy muscular wall of the uterus that contracts during child delivery
(D) A specialized tissue enabling material exchange between mother and embryo

19. How is oxygen and glucose transported from the mother to the developing embryo?
(A) Through the placenta via diffusion
(B) Through direct mixing of the mother's and embryo's blood
(C) Through the amniotic fluid
(D) Through the fallopian tube

20. The placenta contains villi on the embryo's side of the tissue. What is the purpose of these villi?
(A) To safeguard the developing embryo from maternal antibodies
(B) To synthesize and secrete digestive enzymes into the blood
(C) To increase surface area for glucose and oxygen passage
(D) To prevent waste products from moving into maternal circulation

21. What is the approximate duration of normal pregnancy (gestation period) in humans?
(A) 6 months
(B) 7 months
(C) 9 months
(D) 12 months

22. What is the process of delivering the fully formed baby from the mother's body called?
(A) Gestation
(B) Implantation

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are divided, splitting the parent cell into two independent daughter cells.

183. (C) Seedless grapes and bananas
Commercial seedless plant varieties like seedless grapes, bananas, and navel oranges are incapable of producing viable seeds through sexual fertilization. Vegetative propagation, using stem cuttings, suckers, or tissue culture, represents the only reliable agricultural strategy to reproduce these seedless crops while consistently preserving desirable fruit traits across farming cycles.

184. (C) They are essentially identical to each other.
Binary fission is an equational asexual reproductive division operating via mitosis. The single parent cell duplicates its circular or nuclear DNA and divides its cytoplasm symmetrically into two daughter cells. Because no sexual recombination or gametic mixing takes place, the two resulting daughter cells are essentially genetically identical to each other.

185. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Minor genetic variations occur during asexual reproduction because the underlying biochemical reactions responsible for copying DNA are not completely foolproof. Enzyme inaccuracies during nucleotide assembly introduce occasional subtle mutations into duplicated strands, making the biochemical unreliability of DNA replication the direct explanation for minor variations among offspring.

186. (C) Growing a new plant from a seed
Growing a plant from a seed involves sexual reproduction, as seeds form following pollination and the fusion of male and female gametes within flowers. In contrast, growing plants from rose cuttings, potato eyes, or Bryophyllum leaf buds uses vegetative organs directly, representing true methods of asexual vegetative propagation.

187. (B) Ruptures to allow the spore to germinate
The thick outer wall of a spore protects its delicate internal contents during dry or cold conditions. When the spore lands on a moist, warm substrate, it absorbs water, causing the internal cell to swell. This internal pressure causes the thick wall to rupture, allowing a germ tube to sprout.

188. (B) Near-exact DNA replication followed by a single cell division.
In asexually reproducing organisms, genetic stability across generations is maintained by combining near-exact DNA replication with a single mitotic cell division. The parent cell doubles its DNA content during interphase and then splits equally during division, ensuring that each daughter cell receives the exact original chromosome count and DNA mass.

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189. (B) Both halves regenerate into two complete Hydra.
Hydra possesses high regenerative capacity driven by specialized stem cells distributed along its body column. When a Hydra is cut into two halves, each isolated section proliferates new cells and differentiates missing structures, resulting in two complete, fully functional Hydra individuals, each equipped with tentacles and a basal disc.

190. (B) I, II and IV
Asexual reproduction cannot introduce new traits rapidly (statement I), increases population vulnerability to environmental shifts due to genetic uniformity (statement II), and yields identical clones (statement IV). Statement III is false because asexual reproduction drives rapid, exponential population increases rather than very slow growth under favourable conditions.

191. (A) They rapidly break down dead organic matter.
Microorganisms like bacteria and fungi use rapid asexual reproduction to build huge population sizes quickly. In terrestrial and aquatic ecosystems, these dense microbial populations act as vital decomposers, rapidly breaking down complex organic molecules in dead organisms and returning essential inorganic nutrients to the soil and water.

192. (C) Ribosomes (protein synthesis machinery)
Assembling new cellular apparatus alongside replicated DNA requires synthesizing structural proteins, metabolic enzymes, and membrane components. Ribosomes serve as the essential cellular organelles that translate genetic instructions into functional proteins. Without active ribosomes, a dividing cell cannot construct the proteins needed to form new cytoplasm and organelles.

parents
(D) To minimize reliance on advanced ultrasound diagnostic equipment in modern medical facilities

35. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R):
Assertion (A): The testes in males are located outside the abdominal cavity in the scrotum.
Reason (R): Sperm formation requires a temperature slightly higher than the normal body temperature.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

36. Which of the following is a common cause of female infertility related to the reproductive tract?
(A) Excessive production of eggs
(B) Blockage in the fallopian tubes
(C) High thickness of the uterine lining
(D) Regular menstrual cycles

37. Proper nutrition during pregnancy is strictly required for which of the following reasons?
(A) To inhibit the premature onset of normal involuntary childbirth contractions
(B) To suppress metabolic hormone synthesis within the functional placenta
(C) To support proper foetal growth and development
(D) To significantly delay the eventual onset of pubertal development in children

38. Which condition is a common consequence of poor reproductive hygiene in females?
(A) Increased genetic diversity in offspring
(B) Development of male secondary sexual characteristics
(C) Multiple pregnancies
(D) Infections in the reproductive tract

39. Sexual reproduction generates more genetic diversity than asexual reproduction because:
(A) It relies on exact replication of genetic material from a single parent with no errors
(B) It combines genetic material from two different parents
(C) It significantly reduces the total amount of time required to produce viable offspring
(D) It takes place predominantly in external environments outside the parental organisms

40. Select the correct sequence of the pathway followed by sperm from their site of production to the outside of the male body.
(A) Testis → Urethra → Vas deferens
(B) Vas deferens → Testis → Urethra
(C) Testis → Vas deferens → Urethra
(D) Urethra → Testis → Vas deferens

41. At puberty, the ovaries start releasing one mature egg every month. What is this process called?
(A) Menstruation
(B) Ovulation
(C) Fertilisation
(D) Implantation

42. How long does the menstrual cycle typically last in a healthy human female?
(A) About 7 days
(B) About 14 days
(C) About 28 days
(D) About 9 months

43. Which layer of the uterus becomes thick and spongy every month in preparation for receiving a fertilised egg?
(A) The outer serous coat surrounding the uterus
(B) The thick middle muscular layer of myometrium
(C) The endometrium
(D) The narrow muscular channel of the cervical canal

44. What happens to the corpus luteum (the ruptured follicle) if the egg is not fertilised?
(A) It fuses permanently with the epithelial lining of the fallopian tube
(B) It degenerates, triggering hormone drops and menstruation
(C) It slowly differentiates into a fully functional secondary ovarian structure
(D) It synthesizes and releases exceptionally high concentrations of testosterone

45. What is the role of the mucous plug in the cervix during pregnancy?
(A) To block vaginal infections from reaching the foetus
(B) To supply essential metabolic nutrients directly to the developing foetus
(C) To facilitate the structural expansion of the surrounding fallopian tubes

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CHAPTER 10

Sexual Reproduction in Humans

1. Which of the following best defines sexual reproduction in humans?
(A) The production of offspring by a single parent without gamete formation
(B) The formation of new offspring through the fusion of male and female gametes
(C) The division of a single cell to form two identical daughter cells
(D) The development of an organism from an unfertilised egg

2. What is the primary function of the testes in the human male reproductive system?
(A) To store urine before it is excreted
(B) To transport sperm from the epididymis to the urethra
(C) To provide nutrition to the developing embryo
(D) To produce sperm and secrete testosterone

3. Why are the testes located outside the abdominal cavity in the scrotum?
(A) To maintain a temperature lower than the normal body temperature for sperm formation
(B) To protect them from physical injury
(C) To ensure they receive an adequate supply of oxygenated blood
(D) To allow for the direct release of hormones into the bloodstream

4. Which of the following tubes carries sperm from the testes to the urethra?
(A) Fallopian tube
(B) Ureter
(C) Vas deferens
(D) Seminiferous tubule

5. What is the role of the prostate gland and seminal vesicles in the male reproductive system?
(A) They nourish sperm and make their transport easier.
(B) They secrete hormones that regulate male primary sexual functions.
(C) They store sperm cells until they achieve complete motility.
(D) They seal the bladder opening during sexual intercourse and climax.

6. In the human female reproductive system, where are the eggs (ova) produced?
(A) Uterus
(B) Cervix
(C) Fallopian tube
(D) Ovary

7. Which of the following structures is the site of fertilisation in humans?
(A) Uterus
(B) Fallopian tube
(C) Vagina
(D) Ovary

8. What is the function of the uterus in human reproduction?
(A) It serves as the primary site for fertilisation and zygote cleavage.
(B) It produces major female reproductive hormones like oestrogen.
(C) It serves as the site for embryo implantation and development.
(D) It acts as a passage for unfertilised eggs to exit the body cavity.

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9. What happens to the lining of the uterus if fertilisation does not occur?
(A) It permanently hardens to protect the underlying reproductive tissues.
(B) It remains fully intact while awaiting the release of the next mature egg.
(C) It transforms into placental tissue to prepare for future embryo growth.
(D) It breaks down and exits the vagina as blood and mucus.

10. Match the reproductive organs in List I with their functions in List II.
List I: Reproductive Organs
P. Ovary
Q. Testis
R. Vas deferens
S. Fallopian tube
List II: Functions

56. Which structure is responsible for the removal of waste products, such as urea, from the developing embryo's blood?
(A) The mother's kidney directly
(B) The embryo's lungs
(C) The fallopian tube
(D) The placenta

57. The male gamete (sperm) consists of three main parts. Which part contains the genetic material?
(A) The tail
(B) The head
(C) The middle piece
(D) The neck

58. The tail of the human sperm is essential for:
(A) Actively penetrating through the outer protective egg wall
(B) Storing essential metabolic nutrients required for survival
(C) Swimming towards the egg
(D) Synthesizing and secreting specific regulatory hormones

59. Which disease is prevented by the use of condoms during sexual intercourse?
(A) Typhoid
(B) Malaria
(C) Tuberculosis
(D) HIV-AIDS

60. How does a Copper-T prevent pregnancy?
(A) It forms an impenetrable mechanical barrier directly covering the cervix
(B) It signals the ovaries to completely cease the monthly production of eggs
(C) It acts as an IUD to prevent implantation
(D) It releases chemical spermicides that kill sperm prior to vaginal entry

61. A declining female-to-male sex ratio in a population is primarily associated with:
(A) High overall rates of female educational enrollment
(B) Widespread accessibility and use of oral contraceptive pills
(C) A gradual biological increase in rates of male infertility
(D) Female foeticide

62. Which of the following best explains why an egg must be fertilised within a short window after ovulation?
(A) The egg survives for only about 12 to 24 hours after release
(B) The uterus sheds its lining immediately after ovulation
(C) The fallopian tubes close off shortly after the egg enters
(D) Sperm cannot survive in the female body for more than a few minutes

63. During menstruation, the bleeding typically lasts for:
(A) 12 to 15 days
(B) 2 to 8 days
(C) 1 to 2 hours
(D) 20 to 25 days

64. What is the permanent stoppage of the menstrual cycle in females called?
(A) Menarche
(B) Menopause
(C) Ovulation
(D) Parturition

65. Consider the following statements about puberty in boys:
I. The voice begins to crack.
II. The testes begin to produce sperm.
III. The chest and shoulders broaden.
IV. The ovaries begin to secrete oestrogen.
Which of the above statements is/are correct?
(A) I, II and IV only
(B) II, III and IV only
(C) I, II and III only
(D) I, III and IV only

66. The ethical concern primarily associated with prenatal sex determination technologies like ultrasound is that:
(A) They frequently cause irreversible mechanical damage to maternal reproductive organs
(B) Their illegal use for sex-selective female abortion
(C) They induce direct permanent alterations in the inherited genetic makeup of the baby
(D) They structurally block and prevent the normal implantation of the fertilized embryo

67. Which of the following practices promotes reproductive health?
(A) Utilizing reusable unsterilized cloth materials during monthly menstruation
(B) Deliberately avoiding routine medical consultations throughout pregnancy
(C) Daily personal hygiene and clean sanitary products
(D) Engaging in frequent unprotected sexual

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intercourse with multiple partners

68. The fusion of male and female gametes to form a zygote restores the:
(A) Haploid chromosome number
(B) Triploid chromosome number
(C) Polyploid chromosome number
(D) Diploid chromosome number

69. Why is a large number of sperm produced by human males compared to the single egg produced by females?
(A) To compensate for loss during transit and ensure fertilisation
(B) Because individual sperm possess an exceptionally long lifespan in external conditions
(C) Because several sperm cells must simultaneously enter the egg to establish a viable zygote
(D) Because excess sperm function primarily as a supplemental nutrient source for the embryo

70. The embryo gets nutrition from the mother's blood with the help of a special tissue called the placenta. Where is the placenta located?
(A) Embedded in the wall of the uterus
(B) Attached to the ovaries
(C) Floating freely in the fallopian tube
(D) Inside the cervix

71. The umbilical cord connects the:
(A) Uterus to the fallopian tube
(B) Ovaries to the uterus
(C) Cervix to the vagina
(D) Foetus to the placenta

72. Which vitamin is highly recommended for women during early pregnancy to prevent neural tube defects in the embryo?
(A) Ascorbic acid (Vitamin C)
(B) Folic acid
(C) Phylloquinone (Vitamin K)
(D) Retinol (Vitamin A)

73. A condition where a couple is unable to conceive a child after a year of unprotected intercourse is termed:
(A) Menopause
(B) Contraception
(C) Infertility
(D) Implantation

74. Which of the following is a symptom of the sexually transmitted disease Syphilis?
(A) Warts on the genitals
(B) Complete loss of immunity leading to opportunistic infections
(C) Severe respiratory distress
(D) Painless sores (chancres) on the genitals and rashes

75. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R):
Assertion (A): The placenta contains villi on the embryo side.
Reason (R): Villi provide a large surface area for glucose and oxygen to pass from the mother to the embryo.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

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76. In which part of the female reproductive system does the cleavage of the zygote begin?
(A) Uterus
(B) Vagina
(C) Fallopian tube
(D) Ovary

77. Which structure acts as the birth canal during parturition?
(A) Fallopian tube
(B) Vagina
(C) Ovary
(D) Ureter

78. Which of the following statements about oral contraceptive pills is incorrect?
(A) They require strict daily administration by the female
(B) They prevent the monthly ovulation and release of mature eggs
(C) They protect against STDs
(D) They alter the natural endocrine and hormonal levels of the body

79. The term 'foetus' is generally used to describe the human embryo from which stage of development?
(A) On the exact calendar day when fertilisation takes place
(B) Immediately prior to embryo implantation into the uterine wall
(C) Following complete expulsion during birth
(D) When major body parts are identifiable

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80. Arrange the following events of human reproduction in the correct chronological order:
I. Fertilisation
II. Gametogenesis
III. Implantation
IV. Zygote formation
(A) II, I, IV, III
(B) I, II, III, IV
(C) II, IV, I, III
(D) IV, I, II, III

81. The process of forming sperm in the testes is specifically called:
(A) Oogenesis
(B) Spermatogenesis
(C) Parthenogenesis
(D) Morphogenesis

82. Which part of the male reproductive system acts to store sperm temporarily while they mature?
(A) Urethra
(B) Prostate gland
(C) Seminal vesicle
(D) Epididymis

83. The muscular neck of the uterus that opens into the vagina is called the:
(A) Fundus
(B) Cervix
(C) Fallopian tube
(D) Clitoris

84. Which of the following is true regarding human gametes?
(A) Sperm and egg cells are both actively motile
(B) Neither sperm cells nor egg cells possess motility
(C) Sperm are motile while eggs are non-motile
(D) Eggs are motile while sperm are non-motile

85. The hormone that maintains the uterine lining during pregnancy is:
(A) Progesterone
(B) Testosterone
(C) Insulin
(D) Adrenaline

86. Which of the following forms of contraception can cause side effects like irregular menstrual bleeding due to hormonal imbalance?
(A) Condoms
(B) Oral pills
(C) Vasectomy
(D) Tubectomy

87. What is a common cause of male infertility?
(A) Overproduction of testosterone
(B) High sperm motility
(C) Low sperm count
(D) Regular use of barrier contraceptives

88. Safe motherhood practices include which of the following?
(A) Avoiding tetanus vaccinations
(B) Engaging in highly strenuous physical labour until childbirth
(C) Consuming a diet poor in iron and calcium
(D) Regular antenatal check-ups and institutional delivery

89. Which of the following is the most direct consequence of rapid population growth?
(A) Rapid expansion in the availability and accessibility of natural resources
(B) Sustained improvement in the general standard of living for all citizens
(C) Increased strain on essential food, housing, and healthcare
(D) A significant nationwide decrease in the overall rate of unemployment

90. Match the disease in List I with its causal agent type in List II.
List I: Disease
P. Gonorrhoea
Q. HIV-AIDS
R. Genital Warts
S. Syphilis
List II: Causal Agent Type
1. Bacteria
2. Virus
3. Virus
4. Bacteria
(A) P-1, Q-2, R-3, S-4
(B) P-4, Q-3, R-2, S-1
(C) P-2, Q-1, R-4, S-3
(D) P-1, Q-4, R-3, S-2

91. The primary advantage of sexual reproduction over asexual reproduction is that it:
(A) Rapidly produces a vastly larger number of offspring within a much shorter timeframe
(B) Generates genetic variation for adaptation and survival
(C) Requires significantly lower amounts of cellular energy and metabolic effort to complete
(D) Bypasses the biological necessity of producing highly specialized reproductive cells

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but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

116. A doctor advises a couple to undergo IVF because the female's fallopian tubes are blocked. Why are blocked fallopian tubes a cause of infertility?
(A) They completely prevent the development and production of mature eggs
(B) They block sperm from meeting the egg
(C) They cause the uterine environment to actively reject implanted embryos
(D) They halt the essential endocrine secretion of key female hormones

117. In the IVF process, after the egg is fertilised in the lab, what is placed inside the female's uterus?
(A) The unfertilised egg
(B) The sperm only
(C) The early embryo
(D) The placenta

118. Which fluid surrounds and protects the developing foetus in the uterus?
(A) Seminal fluid
(B) Cerebrospinal fluid
(C) Lymphatic fluid
(D) Amniotic fluid

119. A lack of proper hygiene during menstruation can lead to which of the following?
(A) Permanently reduced fertility caused by major endocrine shifts
(B) Pelvic inflammatory infections
(C) Premature and sudden clinical onset of menopause
(D) Rapid and unexplainable metabolic weight gain

120. Select the correct order of stages in human embryonic development:
(A) Zygote → Cleavage → Blastocyst → Implantation
(B) Cleavage → Zygote → Implantation → Blastocyst
(C) Blastocyst → Implantation → Zygote → Cleavage
(D) Implantation → Blastocyst → Cleavage → Zygote

121. The main function of the amniotic sac is to:
(A) Serve as the primary anatomical site for fertilisation
(B) Store oxygenated maternal blood for foetal usage
(C) Cushion and protect the foetus
(D) Synthesize and secrete key reproductive hormones

122. Which of the following describes a male secondary sexual characteristic?
(A) Enlargement of breasts
(B) Widening of hips
(C) Onset of the menstrual cycle
(D) Growth of a beard and moustache

123. The breakdown of the thickened uterine lining along with its blood vessels is known as:
(A) Ovulation
(B) Menstruation
(C) Implantation
(D) Parturition

124. What is the role of oestrogen in the female reproductive cycle?
(A) It stimulates the production of sperm
(B) It promotes the thickening of the uterine lining
(C) It causes the breakdown of the corpus luteum
(D) It prevents the growth of secondary sexual characteristics

125. The gestation period in humans is approximately 280 days. From which event is this typically calculated in medical practice?
(A) The estimated calendar day of egg fertilisation
(B) The start of the last menstrual period
(C) The exact day when embryo implantation occurs
(D) The initial day when foetal movement is detected

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126. Which procedure is sometimes misused for prenatal sex determination?
(A) Blood pressure monitoring
(B) Ultrasound scanning
(C) ECG (Electrocardiogram)
(D) EEG (Electroencephalogram)

127. Why is female foeticide considered a serious social and demographic issue?
(A) It directly contributes to an unprecedented global overpopulation crisis
(B) It causes an imbalanced sex ratio with fewer females
(C) It induces premature reproductive aging and early menopause in women
(D) It rapidly increases the overall transmission rate of severe STDs

(A) The acrosome
(B) The mitochondrial middle piece
(C) The elongated flagellar tail
(D) The central nuclear region

105. Consider the following statements about the menstrual cycle:
I. It stops temporarily during pregnancy.
II. It marks the release of an unfertilised egg along with the uterine lining.
III. It typically occurs once every 28 days.
IV. It continues indefinitely until the end of a female's life.
Which of the above statements is/are correct?
(A) I, II and III only
(B) II, III and IV only
(C) I, III and IV only
(D) I, II and IV only

106. In sexually reproducing organisms, the gametes are:
(A) Haploid (containing half the chromosome set)
(B) Diploid (containing two complete matching sets of chromosomes)
(C) Triploid (containing three complete sets of nuclear chromosomes)
(D) Tetraploid (containing four complete sets of active chromosomes)

107. Which statement correctly contrasts sperm and egg cells?
(A) Sperm cells are structurally large and store food, whereas egg cells are tiny and motile.
(B) Sperm are small and motile, whereas eggs are large and non-motile.
(C) Both sperm and egg cells possess high independent motility and identical dimensions.
(D) Both male and female gametes completely lack functional cell nuclei until fertilization.

108. The main reason for implementing family planning programs at the national level is:
(A) To significantly promote and increase the national occurrence of twin births
(B) To improve maternal-child health and regulate population
(C) To enforce legally mandated surgical sterilization for all adult individuals
(D) To systematically reduce and eliminate natural genetic variations in humans

109. What is the immediate consequence of the fusion of a sperm and an ovum?
(A) Formation of an embryo
(B) Formation of a foetus
(C) Formation of a placenta
(D) Formation of a zygote

110. Which part of the female reproductive system receives the semen during sexual intercourse?
(A) Uterus
(B) Fallopian tube
(C) Vagina
(D) Ovary

111. What structure develops from the follicle after ovulation and secretes progesterone?
(A) Corpus luteum
(B) Endometrium
(C) Cervix
(D) Acrosome

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112. HIV, the virus that causes AIDS, attacks which system of the human body?
(A) Digestive system
(B) Immune system
(C) Skeletal system
(D) Muscular system

113. Which of the following methods of contraception also helps in preventing sexually transmitted diseases?
(A) Copper-T
(B) Oral pills
(C) Condoms
(D) Vasectomy

114. The term 'menarche' refers to the:
(A) Stoppage of the menstrual cycle
(B) Shedding of the uterine lining during pregnancy
(C) Release of the egg from the ovary
(D) First menstrual cycle in a female

115. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R):
Assertion (A): Vasectomy is considered a highly effective, permanent method of contraception in males.
Reason (R): It involves tying or cutting the vas deferens, preventing sperm from entering the semen.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true

92. The inner lining of the uterus is called the endometrium. What happens to it during pregnancy?
(A) It breaks down and sheds every single month
(B) It structurally transforms into the fallopian tube
(C) It detaches completely to form the outer amniotic sac
(D) It remains intact to support the developing foetus

93. A zygote possesses which set of chromosomes?
(A) One set of maternal and one set of paternal chromosomes
(B) Only maternal chromosomes
(C) Only paternal chromosomes
(D) Two sets of maternal and two sets of paternal chromosomes

94. What is the role of the fluid secreted by the seminal vesicles and prostate gland?
(A) It significantly decreases the progressive motility and movement of sperm cells
(B) It selectively eliminates weaker sperm cells prior to the act of ejaculation
(C) It directly triggers the initial onset of meiotic division in testicular tissues
(D) It aids sperm transport and provides nutrition

95. Consider the following statements regarding Sexually Transmitted Diseases (STDs):
I. They can be transmitted through unprotected sexual contact.
II. Syphilis is a viral STD.
III. Condoms provide some protection against the transmission of STDs.
Which of the above statements is/are incorrect?
(A) I only
(B) II only
(C) III only
(D) I and III only

96. During which process does the follicle in the ovary burst to release a mature egg?
(A) Menstruation
(B) Ovulation
(C) Fertilisation
(D) Gestation

97. The surgical cutting and tying of the fallopian tubes is a permanent method of contraception. How does it work?
(A) It completely suppresses the maturation and production of eggs by the ovary
(B) It halts the cyclic breakdown and monthly shedding of the uterine lining
(C) It destroys sperm cells instantly upon their entry into the female tract
(D) It prevents gametes from meeting in the fallopian tube

98. Why is the urethra considered a common duct in human males?
(A) Because it serves as a passage for both urine and semen
(B) Because it transports both blood and lymph
(C) Because it is shared by both the digestive and excretory systems
(D) Because it is found in both males and females

99. Which of the following is an example of an assisted reproductive technology (ART)?
(A) Surgical vasectomy procedure
(B) Intrauterine Copper-T insertion
(C) In Vitro Fertilisation
(D) Surgical tubal ligation procedure

100. A pregnant woman's diet should be rich in iron to prevent:
(A) Gestational diabetes
(B) Anaemia
(C) Morning sickness
(D) Calcium deficiency

101. Which phase of the human life cycle is characterised by the maturation of reproductive organs?
(A) Childhood
(B) Senescence
(C) Puberty
(D) Infancy

102. What physical change occurs in females during puberty that does not occur in males?
(A) Appearance of hair in armpits
(B) Onset of menstruation
(C) Increase in height
(D) Secretion of sweat and oil from skin glands

103. If a female's menstrual cycle is normally 28 days, ovulation typically occurs around day:
(A) 1
(B) 7
(C) 14
(D) 28

104. Which part of the sperm contains enzymes that help it penetrate the egg?

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128. Intrauterine devices (IUDs) like Copper-T are inserted into which part of the female reproductive tract?
(A) Vagina
(B) Cervix
(C) Uterus
(D) Fallopian tube

129. What is a primary disadvantage of using oral contraceptive pills?
(A) They necessitate invasive surgical insertion procedures
(B) They permanently render a female completely sterile
(C) They frequently cause painful mechanical injuries to cervical tissue
(D) They do not protect against STDs

130. Match the reproductive terms in List I with their descriptions in List II.
List I: Reproductive Terms
P. Menstruation
Q. Gestation
R. Parturition
S. Menopause
List II: Description
1. The process of childbirth
2. Permanent end of the menstrual cycle
3. The shedding of the uterine lining
4. The duration of pregnancy
(A) P-3, Q-4, R-1, S-2
(B) P-4, Q-3, R-2, S-1
(C) P-3, Q-1, R-4, S-2
(D) P-2, Q-4, R-1, S-3

131. Which of the following is true about asexual reproduction compared to sexual reproduction?
(A) It fundamentally requires the union and fusion of specialized gametes
(B) It produces offspring genetically identical to the parent
(C) It serves as the primary mode of biological reproduction in human beings
(D) It strictly necessitates two genetically distinct parent organisms

132. The testes are structurally composed of highly coiled tubes called:
(A) Fallopian tubes
(B) Seminiferous tubules
(C) Eustachian tubes
(D) Bronchioles

133. Which cellular process reduces the chromosome number by half during the formation of sperm and egg?
(A) Mitosis
(B) Meiosis
(C) Binary fission
(D) Budding

134. After fertilisation, the zygote begins to travel towards the uterus. What drives its movement through the fallopian tube?
(A) Autonomous flagellar propulsive motion generated by the zygote
(B) Ciliary beating and muscular contractions in the tube
(C) Hydrostatic pressure combined with gravitational pull alone
(D) Continuous fluid secretions from the ovary pushing it forward

135. Consider the following statements about the placenta:
I. It is a disc-shaped tissue embedded in the uterine wall.
II. It transfers carbon dioxide and waste from the embryo to the mother's blood.
III. It prevents all viruses and harmful drugs from reaching the foetus.
Which of the above statements is/are incorrect?
(A) I only
(B) II only
(C) III only
(D) I and II only

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136. What is the function of the middle piece of a human sperm?
(A) It houses the main cell nucleus containing inherited genetic material
(B) Its mitochondria supply energy for sperm motility
(C) It stores specialized digestive enzymes to penetrate the egg wall
(D) It functions primarily as a physical rudder for steering direction

137. Which of the following is an example of a chemical method of contraception?
(A) Barrier condoms
(B) Surgical vasectomy
(C) Spermicides
(D) Intrauterine Copper-T

138. The Pre-Conception and Pre-Natal Diagnostic Techniques (PCPNDT) Act was enacted in India primarily to:
(A) Heavily subsidize the purchasing cost of ultrasound machines
(B) Prevent female foeticide
(C) Broadly promote and fund assisted reproductive technologies
(D) Completely ban all forms of modern diagnostic medical imaging

139. Which STD can severely compromise the immune system, leaving the body vulnerable to minor infections?
(A) Syphilis
(B) Gonorrhoea
(C) Genital warts
(D) HIV-AIDS

140. Regular antenatal care during pregnancy involves monitoring the mother's blood pressure primarily to check for:
(A) Gestational diabetes mellitus
(B) Ectopic tubal pregnancy
(C) Pre-eclampsia
(D) Chromosomal Down syndrome

141. The failure of the testes to descend into the scrotum before birth can lead to:
(A) Precocious and abnormally early onset of premature puberty
(B) Sterility from impaired sperm production
(C) Pathological overproduction of systemic testosterone hormones
(D) Significantly increased and hyperactive sperm cell motility

142. The process of oogenesis results in the formation of:
(A) Four equal functional eggs from one precursor cell
(B) One large functional egg and smaller polar bodies
(C) Millions of small motile eggs
(D) Diploid gametes

143. Which of the following is NOT a part of the female reproductive system?
(A) Ovary
(B) Uterus
(C) Vas deferens
(D) Fallopian tube

144. In humans, the sex of the child is genetically determined by the:
(A) Mother, because her egg exclusively provides the X chromosome
(B) Father, as he contributes an X or Y chromosome
(C) Environmental temperature and pH conditions inside the uterus
(D) Maternal dietary nutrition provided during early pregnancy stages

145. Consider the following statements regarding In Vitro Fertilisation (IVF):
I. Fertilisation takes place outside the female body.
II. It is commonly referred to as the 'test-tube baby' technique.
III. It is used when a woman has blocked fallopian tubes or the male has a low sperm count.
IV. The resulting foetus develops entirely outside the mother's body in an incubator.
Which of the above statements is/are correct?
(A) I, II and IV only
(B) I, II and III only
(C) II, III and IV only
(D) I, III and IV only

146. Which of the following changes during puberty is triggered by testosterone?
(A) Distinct structural broadening of the pelvic hip bones
(B) Pronounced growth and development of glandular breast tissue
(C) Vocal deepening and Adam's apple growth
(D) Regular monthly initiation of the female menstrual cycle

147. Why is adolescence considered a vulnerable phase for reproductive health?
(A) Maturation increases curiosity and risk of STDs
(B) Because it represents the sole period in human life when physical growth occurs
(C) Because bodily immune systems undergo temporary and total functional shutdowns
(D) Because adolescent individuals experience natural temporary reproductive sterility

148. What is the role of the fimbriae (finger-like projections) at the end of the fallopian tube?
(A) To synthesize and secrete the primary female sex hormone oestrogen
(B) To capture the released ovum
(C) To function as an impenetrable mechanical barrier against moving sperm

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(D) To anchor and physically attach the placenta to the uterine wall

149. The surgical removal of the uterus is medically termed as:
(A) Vasectomy
(B) Tubectomy
(C) Hysterectomy
(D) Oophorectomy

150. A couple wants to space their children by three years. Which contraceptive method is highly suitable and reversible for this purpose?
(A) Tubectomy
(B) Vasectomy
(C) Copper-T (IUD)
(D) Surgical removal of ovaries

151. Which nutrient is essential for maintaining strong bones in a pregnant woman and developing the foetus's skeleton?
(A) Vitamin C
(B) Calcium
(C) Iron
(D) Iodine

152. Which of the following is a potential cause of female infertility?
(A) Highly predictable and regular monthly ovulation cycles
(B) PCOS causing irregular ovulation
(C) Optimal structural thickness of the uterine endometrium
(D) Frequent dietary consumption of iron-rich healthy foods

153. What ensures that only one sperm fertilises an egg in humans?
(A) The egg actively secretes enzymes to destroy all rival sperm cells
(B) Surface changes on the egg block additional sperm
(C) Male ejaculation produces only one single functional sperm at a time
(D) The surrounding fallopian tube completely closes after one sperm passes

154. If a woman uses a Copper-T, will it protect her from sexually transmitted diseases?
(A) Yes, it provides complete protection
(B) Yes, it kills viruses and bacteria
(C) No, it only prevents pregnancy, not STDs
(D) No, because it is only inserted for a few hours

155. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R):
Assertion (A): The inner lining of the uterus thickens every month.
Reason (R): It prepares itself to receive and nourish a growing embryo.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

156. The structure that provides a physical and nutritional connection between the foetus and the placenta is the:
(A) Fallopian tube
(B) Cervix
(C) Umbilical cord
(D) Amnion

157. Which process immediately precedes the expulsion of the baby during normal childbirth?
(A) Successful implantation of the blastocyst into the uterus
(B) Cervical dilation and uterine contractions
(C) Monthly shedding and expulsion of the unfertilised egg
(D) Gradual hormonal thickening of the uterine endometrium

158. What is the typical sign that indicates the beginning of the menstrual cycle (Day 1)?
(A) The release of an egg from the ovary
(B) The start of menstrual bleeding
(C) The thickening of the uterine lining
(D) The spike in testosterone levels

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159. Which condition occurs when the fertilised egg implants outside the uterus, most commonly in the fallopian tube?
(A) Normal gestation
(B) Ectopic pregnancy
(C) Parturition
(D) Endometriosis

160. Arrange the following events of the menstrual cycle in the correct order, starting from the end of menstruation:
I. Breakdown of the uterine lining (Menstruation)
II. Release of the egg (Ovulation)
III. Thickening of the uterine lining begins

IV. The unfertilised egg reaches the uterus
(A) III, II, IV, I
(B) I, II, III, IV
(C) III, IV, II, I
(D) II, III, I, IV

161. The process of forming female gametes (ova) is called:
(A) Spermatogenesis
(B) Oogenesis
(C) Organogenesis
(D) Parthenogenesis

162. How does breastfeeding immediately after birth benefit the newborn?
(A) It eliminates the immediate biological need for newborn respiration
(B) Colostrum supplies key protective antibodies
(C) It permanently immunizes the newborn against all sexually transmitted diseases
(D) It temporarily halts gastrointestinal development to protect premature organs

163. The hormone primarily responsible for stimulating the contractions of the uterus during childbirth is:
(A) Oestrogen
(B) Progesterone
(C) Oxytocin
(D) Insulin

164. What is the primary purpose of washing the genital area regularly and maintaining good hygiene?
(A) To induce permanent cessation of cellular sperm production
(B) To prevent reproductive tract infections
(C) To significantly elevate the biological probability of twin births
(D) To directly alter and mutate the nuclear genetic makeup of gametes

165. A vasectomy prevents pregnancy by:
(A) Completely halting the primary synthesis of sperm in testicular tissue
(B) Blocking the sperm exit pathway
(C) Drastically reducing circulating testosterone hormone concentrations
(D) Chemically destroying mature sperm cells stored inside the epididymis

166. Which sexually transmitted disease is characterised by a weakened immune system making the person susceptible to other severe infections?
(A) Syphilis
(B) Gonorrhoea
(C) AIDS
(D) Genital Warts

167. Why is early marriage and teenage pregnancy generally discouraged from a health perspective?
(A) The female body is not yet fully mature for pregnancy
(B) Adolescent pregnancies invariably result in twin or multiple gestations
(C) It causes an instantaneous and permanent cessation of paternal growth
(D) The overall genetic variation and diversity of offspring is severely restricted

168. Which of the following best describes the path of an unfertilised egg in the female body?
(A) Ovary → Uterus → Fallopian tube → Vagina
(B) Ovary → Fallopian tube → Uterus → Vagina
(C) Uterus → Fallopian tube → Ovary → Vagina
(D) Vagina → Uterus → Fallopian tube → Ovary

169. What is the role of the vaginal canal in reproduction?
(A) It serves as the primary ovarian organ that produces the female egg
(B) It functions as the principal anatomical site where fertilisation occurs
(C) It receives sperm and acts as the birth canal
(D) It secretes systemic endocrine hormones regulating monthly menstrual cycles

170. Match the male reproductive structures in List I with their characteristic features in List II.

List I: Male Reproductive Structure
P. Scrotum
Q. Testis
R. Vas deferens
S. Urethra

List II: Characteristic Feature
1. Common passage for urine and sperm
2. Tube that carries sperm out of the scrotal sac
3. Pouch of skin that regulates temperature
4. Oval organ that produces sperm

(A) P-3, Q-4, R-2, S-1
(B) P-4, Q-3, R-1, S-2
(C) P-3, Q-2, R-4, S-1
(D) P-2, Q-4, R-3, S-1

171. The legal minimum age for marriage in India is set at 18 for females and 21 for males primarily to:

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(A) Ensure maturity and better reproductive health
(B) Ensure both partners have completed advanced post-graduate university degrees
(C) Ensure total personal financial independence and career stability before marriage
(D) Artificially delay the biological onset of pubertal development in adolescents

172. Which structure produces a sugary fluid (fructose) that provides energy to the sperm?
(A) Prostate gland
(B) Seminal vesicle
(C) Epididymis
(D) Urethra

173. What is the diploid chromosome number in a normal human somatic cell compared to a gamete?
(A) 23 in somatic cells, 46 in gametes
(B) 46 in somatic cells, 23 in gametes
(C) 46 in somatic cells, 46 in gametes
(D) 23 in somatic cells, 23 in gametes

174. The process of fusion of a male and a female gamete is called:
(A) Implantation
(B) Pollination
(C) Menstruation
(D) Fertilisation

175. Consider the following statements about implantation:
I. It occurs in the wall of the uterus.
II. It happens roughly a week after fertilisation.
III. It involves the attachment of an unfertilised egg.
Which of the above statements is/are incorrect?
(A) I only
(B) II only
(C) III only
(D) I and II only

176. Which of the following contains the genetic material in a human egg cell?
(A) Cytoplasm
(B) Mitochondria
(C) Nucleus
(D) Cell membrane

177. The term 'semen' refers to:
(A) Pure concentrated sperm cells originating from testicular tissue
(B) Exclusively the fluid secretions produced by the prostate gland
(C) Sperm combined with accessory gland secretions
(D) Clear protective liquid harvested from inside the amniotic sac

178. What happens to the rate of general body growth during early puberty?
(A) It undergoes a drastic and sustained deceleration
(B) It ceases completely across all organ systems
(C) It reverses, resulting in immediate physical weight loss
(D) It undergoes a rapid growth spurt

179. A common physical change in females marking the onset of puberty is:
(A) Significant vocal deepening to lower registers
(B) Marked skeletal broadening of the shoulder girdle
(C) Breast enlargement
(D) Coarse facial hair development across the jawline

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180. Select the correct sequence of events in the female reproductive cycle if fertilisation does NOT occur:
(A) Menstruation → Ovulation → Thickening of uterine lining → Breakdown of lining
(B) Thickening of uterine lining → Menstruation → Ovulation → Breakdown of lining
(C) Menstruation → Thickening of uterine lining → Ovulation → Breakdown of lining
(D) Ovulation → Menstruation → Breakdown of lining → Thickening of uterine lining

181. In the context of contraception, what does IUD stand for?
(A) Internal Uterine Disease
(B) Intrauterine Device
(C) Intravenous Urinary Device
(D) Intravaginal Uterine Dispenser

182. A condom acts as a barrier method. Which of the following is true regarding its use?
(A) It represents a permanent surgical method of contraception
(B) It requires surgical placement
(C) It disrupts the female's menstrual cycle
(D) It prevents sperm from entering the cervix

183. Which of the following practices is crucial for maternal health during the later stages of pregnancy?
(A) Complete restriction of food intake
(B) Engaging routinely in heavy weight-lifting

41. (B) Ovulation
Ovulation is the biological process in the female reproductive cycle wherein a mature ovarian follicle ruptures to release an egg or ovum into the abdominal cavity near the fallopian tube. Triggered by a surge in luteinizing hormone, ovulation typically occurs once every month during the middle of the cycle.

42. (C) About 28 days
The human female menstrual cycle is a repeating biological process regulated by pituitary and ovarian hormones. Lasting approximately twenty-eight days on average in healthy individuals, the cycle encompasses follicular development, ovulation around day fourteen, preparation of the uterine lining, and subsequent menstrual shedding if fertilization does not occur.

43. (C) The endometrium
The endometrium is the vascular inner mucous membrane lining the uterine cavity. Under the influence of rising oestrogen and progesterone levels during each monthly cycle, the endometrium becomes thick, soft, and richly supplied with blood vessels, creating an optimal nutritional environment for potential implantation of a fertilized embryo.

44. (B) It degenerates, triggering hormone drops and menstruation
Following ovulation, the ruptured follicle transforms into the corpus luteum, which secretes progesterone. If fertilization fails to occur, the corpus luteum degenerates into scar tissue. This degeneration causes a sharp decline in progesterone and oestrogen levels, leading to the collapse and shedding of the functional uterine lining during menstruation.

45. (A) To block vaginal infections from reaching the foetus
During pregnancy, elevated progesterone levels stimulate cervical glands to produce thick, dense mucus that forms a protective plug inside the cervical canal. This mucous plug acts as a physical barrier, sealing the uterus and preventing pathogenic bacteria or vaginal infections from entering the uterine cavity and harming the foetus.

46. (D) Urethra
In human males, the urethra is a long muscular tube extending from the urinary bladder through the penis to the external urethral orifice. It serves a dual functional role as a common exit duct for expelling urine from the urinary system and discharging semen containing sperm during reproductive ejaculation.

47. (B) To educate them on bodily changes, hygiene, and safe practices
Reproductive health education provides adolescents with accurate information regarding physical, emotional, and hormonal changes during puberty. Counselling encourages healthy body awareness, promotes proper personal hygiene, corrects misconceptions, and emphasizes safe practices, thereby empowering young individuals to make responsible decisions regarding their personal and reproductive well-being.

48. (A) Cleavage
Cleavage refers to the series of rapid mitotic cell divisions that a single-celled zygote undergoes immediately following fertilization. These successive divisions rapidly increase cell number without expanding the overall size of the embryo, transforming the zygote into a solid ball of cells called a morula and eventually a blastocyst.

49. (C) Sexual reproduction leads to greater genetic variation.
A fundamental difference between modes of reproduction lies in genetic variation. Asexual reproduction requires only one parent and yields offspring that are genetically identical clones. In contrast, sexual reproduction involves the fusion of haploid gametes from two distinct parents, recombining different genetic traits and creating diverse offspring.

50. (A) P-4, Q-3, R-1, S-2
Contraceptive techniques fall into distinct functional categories. A condom functions as a physical barrier blocking sperm entry. A Copper-T is an intrauterine device inserted into the uterus to inhibit implantation. Oral pills provide hormonal intervention to prevent egg release, and a vasectomy represents a permanent surgical sterilization method in males.

51. (D) Puberty
Puberty is the dynamic biological transition during human adolescence marked by rapid physical growth, hormonal surges, and sexual maturation. During this crucial phase, primary reproductive organs become fully functional,

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195. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R):
Assertion (A): Sexual reproduction brings about greater genetic diversity in offspring.
Reason (R): It involves the fusion of gametes from two different individuals, combining different genetic material.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

196. The condition where a male's sperm count is exceptionally low, hindering natural fertilisation, is a factor of:
(A) High fertility
(B) Male infertility
(C) Early puberty
(D) Menopause

197. Which of the following methods permanently prevents the release of eggs from reaching the uterus?
(A) Condoms
(B) Copper-T
(C) Tubectomy
(D) Oral pills

198. An embryo is considered a foetus when:
(A) It exists merely as an undifferentiated single cell
(B) It forms a microscopic hollow multicellular blastocyst
(C) It completes initial attachment into the uterine endometrium
(D) Its main body parts are identifiable

199. What is the significance of the fact that gametes have half the number of chromosomes as regular body cells?
(A) It significantly increases their cellular swimming velocity and kinetic motility
(B) To restore the normal diploid chromosome count in the zygote
(C) It protects reproductive gamete cells from premature cellular degradation
(D) It bypasses and completely eliminates the requirement for fertilization

200. Family planning and population control are essential mainly to:
(A) To deliberately bring about the complete biological extinction of human beings
(B) To improve life quality, maternal health, and resource sustainability
(C) To strictly restrict and eliminate natural genetic variation across populations
(D) To universally mandate permanent surgical contraceptive procedures for all adults

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62. (A) The egg survives for only about 12 to 24 hours after release
Following ovulation, a mature ovum released into the fallopian tube maintains viability for a limited window of twelve to twenty-four hours. If fertilizing sperm do not encounter and penetrate the ovum within this brief biological lifespan, the unfertilized egg rapidly degenerates and is subsequently shed during the next menstruation.

63. (B) 2 to 8 days
Menstruation is the cyclic shedding of the functional inner layer of the uterine wall when fertilization does not take place. In healthy human females, menstrual bleeding typically lasts between two to eight days, during which blood, tissue fluid, and cellular debris exit the uterine cavity through the vagina.

64. (B) Menopause
Menopause marks the permanent cessation of primary ovarian function and monthly menstrual cycles in human females, typically occurring between forty-five and fifty-five years of age. Diagnosed after twelve consecutive months without menstruation, menopause results from the natural depletion of ovarian follicles and a sharp reduction in oestrogen production.

65. (C) I, II and III only
Puberty in boys is driven by testicular testosterone production. This hormonal onset initiates spermatogenesis inside seminiferous tubules and promotes male secondary sexual characteristics. Observed changes include vocal cord thickening causing voice cracking, broadening of the chest and shoulders, increased skeletal muscle development, and growth of facial and body hair.

66. (B) Their illegal use for sex-selective female abortion
Advanced non-invasive diagnostic imaging techniques like ultrasound allow precise visual evaluation of foetal growth during pregnancy. However, the illegal and unethical misuse of these medical technologies to determine foetal gender often leads to sex-selective abortions targeting female foetuses, creating severe demographic imbalances and raising critical social and ethical concerns.

67. (C) Daily personal hygiene and clean sanitary products
Promoting reproductive health relies on maintaining proper personal hygiene and utilizing clean, sterile sanitary products during menstruation. Regular bathing, washing external genitalia, and frequently changing sanitary pads prevent harmful microbial proliferation, thereby protecting individuals against painful urinary tract infections, pelvic inflammatory diseases, and long-term reproductive complications.

68. (D) Diploid chromosome number
Human somatic cells are diploid, containing forty-six chromosomes arranged in twenty-three pairs. During gametogenesis, meiotic cell division reduces this chromosome number by half, creating haploid gametes with twenty-three single chromosomes each. Fertilization unites sperm and egg nuclei, restoring the full diploid chromosome complement of forty-six in the zygote.

69. (A) To compensate for loss during transit and ensure fertilisation
Human males produce hundreds of millions of sperm cells per ejaculation, whereas females release only one egg per cycle. Millions of sperm die within the acidic vaginal environment or fail to traverse the female tract. Producing huge numbers ensures that sufficient motile sperm survive the journey to achieve fertilization.

70. (A) Embedded in the wall of the uterus
The placenta is an organ that develops during pregnancy and becomes physically embedded within the vascular inner wall of the mother's uterus, known as the endometrium. It establishes a physiological interface connecting maternal circulation with embryonic vessels in the umbilical cord, facilitating nutrient transfer and gas exchange.

71. (D) Foetus to the placenta
The umbilical cord is a flexible, vascular canal that connects the abdomen of the developing foetus directly to the placenta. Containing two umbilical arteries and one umbilical vein, it transports oxygenated, nutrient-rich blood from the placenta to the foetus while carrying metabolic wastes away to maternal circulation.

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10. (A) P-3, Q-4, R-1, S-2
Human reproductive structures perform distinct functional roles during reproduction. The ovaries produce female gametes known as eggs, while the testes generate male gametes called sperm. The vas deferens serves as a muscular tube transporting sperm from the testes, and the fallopian tube provides the physiological site where sperm fertilizes the egg.

11. (B) Testosterone
Testosterone is the primary androgenic hormone produced by the interstitial Leydig cells of the male testes. During puberty, increased secretion of testosterone triggers major physical changes in males, including voice deepening, facial and body hair growth, muscle mass development, and the structural maturation of male internal and external reproductive organs.

12. (C) Cracking of the voice and growth of facial hair
Puberty in males is marked by physical changes induced by rising levels of testosterone. Common secondary sexual traits that emerge during this developmental stage include the deepening or cracking of the voice due to larynx enlargement, the growth of facial, pubic, and axillary body hair, and an increased overall muscle mass.

13. (D) Oestrogen and progesterone
The female ovaries serve as essential endocrine glands that synthesize and secrete two major steroid hormones: oestrogen and progesterone. Oestrogen promotes the development of female secondary sexual characteristics and uterine lining growth, while progesterone prepares and maintains the inner lining of the uterus for potential embryo implantation and ongoing pregnancy.

14. (A) Menarche
Menarche represents the first occurrence of menstrual bleeding in a female during pubertal development, signifying the functional onset of the female reproductive life stage. Typically occurring between eleven and fifteen years of age, menarche indicates that the ovaries have begun cyclic maturation and release of eggs under normal hormonal regulation.

15. (C) I and III only
Human fertilization is defined as the biological fusion of a haploid male sperm cell with a haploid female ovum, combining two sets of single chromosomes. This process takes place within the fallopian tube of the female reproductive system and restores the full diploid chromosome number, resulting in a single-celled zygote.

16. (C) Zygote
A zygote is the single diploid cell formed immediately upon the successful fusion of a male gamete with a female gamete during fertilization. It contains a complete set of maternal and paternal chromosomes. The zygote subsequently undergoes rapid mitotic cell divisions, progressing through embryonic stages to eventually form a multi-cellular foetus.

17. (B) Implantation
Implantation is the crucial developmental process in which a young blastocyst, formed after repeated cell divisions of the zygote, attaches to and embeds into the vascular inner lining of the uterus. This event establishes the essential maternal-foetal connection necessary for receiving nutrients and oxygen required for full gestational development.

18. (D) A specialized tissue enabling material exchange between mother and embryo
The placenta is a specialized temporary organ formed jointly by maternal uterine tissue and embryonic tissue during pregnancy. Embedded in the uterine wall, it provides a structural and functional physiological interface that facilitates the transfer of oxygen and nutrients from maternal blood to the developing embryo while simultaneously removing embryonic wastes.

19. (A) Through the placenta via diffusion
Maternal blood flowing through spaces in the uterine wall surrounds embryonic chorionic villi within the placenta. Oxygen and essential nutrients such as glucose dissolve in maternal blood and cross the thin placental barrier into embryonic blood vessels via passive and facilitated diffusion, fulfilling the growing respiratory and metabolic needs.

20. (C) To increase surface area for glucose and oxygen passage
Chorionic villi are finger-like microscopic projections on the foetal side of the placenta that extend into pools of maternal blood. Their highly folded design drastically increases the available surface area for efficient molecular diffusion,

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exercises
(C) Sleeping only in an upright position
(D) Adequate rest and regular medical check-ups

184. The most significant advantage of having genetic variation in a human population is:
(A) It causes all individuals in a population to appear phenotypically identical
(B) It improves species survival in changing environments
(C) It systematically decreases the biological necessity for sexual reproduction
(D) It completely immunizes the species against all inherited genetic diseases

185. Consider the following statements comparing sexual and asexual reproduction:
I. Asexual reproduction involves a single parent.
II. Sexual reproduction requires the formation and fusion of gametes.
III. Sexual reproduction generates greater variation in offspring.
IV. Asexual reproduction is the primary method of reproduction in humans.
Which of the above statements is/are correct?
(A) I, II and IV only
(B) II, III and IV only
(C) I, II and III only
(D) I, III and IV only

186. The period from fertilisation to the birth of the baby is called the:
(A) Incubation period
(B) Gestation period
(C) Menstrual period
(D) Lactation period

187. Which structure acts as a temporary endocrine gland during pregnancy, secreting hormones to maintain the pregnancy?
(A) Fallopian tube
(B) Cervix
(C) Urethra
(D) Placenta

188. Why is regular cleaning of the foreskin in males and the vulval area in females important?
(A) To prevent bacterial and fungal infections
(B) To trigger a significantly earlier biological onset of adolescent puberty
(C) To permanently halt and suppress the cellular production of functional gametes
(D) To substantially elevate the degree of genetic diversity in future offspring

189. A person suffering from Gonorrhoea is likely infected by a:
(A) Virus
(B) Fungus
(C) Bacteria
(D) Protozoan

190. Arrange the typical stages of normal childbirth (parturition) in the correct order:
I. Delivery of the placenta (afterbirth)
II. Dilation of the cervix
III. Expulsion (delivery) of the baby
(A) II, III, I
(B) I, II, III
(C) III, II, I
(D) II, I, III

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191. To prevent the transmission of HIV/AIDS, which of the following is an effective measure?
(A) Sharing hypodermic medical needles for injection
(B) Using condoms during intercourse
(C) Inserting an intrauterine contraceptive device
(D) Regularly taking oral hormonal contraceptive pills

192. Which of the following represents the correct paired combination of an organ and its primary reproductive hormone in humans?
(A) Testis - Oestrogen
(B) Ovary - Testosterone
(C) Prostate - Progesterone
(D) Testis - Testosterone

193. The developing embryo relies on the placenta for the removal of which metabolic waste?
(A) Oxygen
(B) Carbon dioxide
(C) Glucose
(D) Amino acids

194. In the absence of a viable sperm, what will happen to a mature ovum in the fallopian tube?
(A) It will undergo spontaneous division to form an identical genetic clone
(B) It will migrate backwards to the ovary and reattach to the follicular wall
(C) It will permanently embed itself directly into the upper fallopian wall
(D) It degenerates and sheds during menstruation

31. (C) To regulate child spacing and control population growth
Family planning encompasses educational, medical, and social activities that allow individuals and couples to freely decide the number and spacing of their children. Promoting accessible contraceptive options helps safeguard maternal and infant health, reduces unintended pregnancies, and plays a vital role in stabilizing overall national population growth rate.

32. (D) In Vitro Fertilisation
The acronym IVF stands for In Vitro Fertilisation, a prominent assisted reproductive technology designed to assist individuals facing fertility challenges. The Latin term in vitro translates to in glass, reflecting the laboratory procedure where male sperm and female ova are combined outside the living body inside controlled medical laboratory glassware.

33. (A) In a laboratory dish outside the body
In Vitro Fertilisation is an assisted reproductive procedure where mature eggs extracted from female ovaries are combined with prepared male sperm in a specialized culture dish within a controlled laboratory environment. After successful fertilization occurs outside the body, resulting early embryos are monitored before transfer into the maternal uterus.

34. (B) To prevent female foeticide and maintain a healthy sex ratio
Prenatal sex determination using diagnostic ultrasound technologies is strictly prohibited by law in India to combat the widespread social practice of sex-selective female abortion. Banning these tests protects female foetuses, prevents gender-biased terminations, and helps correct severe demographic imbalances in the overall male-to-female ratio across the population.

35. (C) Assertion (A) is true but Reason (R) is false.
The human testes are located outside the abdominal cavity within the scrotum because functional sperm production requires an environment two to two and a half degrees lower than core body temperature, not higher. Consequently, the assertion stating their external location is true, whereas the reason citing higher temperature is false.

36. (B) Blockage in the fallopian tubes
Blockage of the fallopian tubes is a primary cause of female infertility because it creates a mechanical barrier within the reproductive tract. Since fertilization naturally occurs inside the fallopian tube, an obstruction prevents sperm from ascending to reach the mature egg, thereby entirely blocking the possibility of natural conception.

37. (C) To support proper foetal growth and development
A balanced maternal diet rich in protein, minerals, and vitamins during pregnancy is essential to satisfy the high metabolic demands of embryonic growth. Proper nutrition ensures adequate blood formation, supports organ development in the growing foetus, and prevents developmental abnormalities or severe birth complications for both mother and child.

38. (D) Infections in the reproductive tract
Maintaining proper personal and menstrual hygiene is essential for preserving female reproductive health. Neglecting basic cleanliness, using unhygienic materials during menstruation, or failing to clean the genital region can encourage rapid bacterial or fungal growth, leading to pelvic inflammatory diseases and severe reproductive tract infections.

39. (B) It combines genetic material from two different parents
Sexual reproduction enhances genetic diversity because it combines unique haploid genomes from two distinct individuals via gamete fusion. During gamete formation through meiosis, genetic recombination and independent assortment introduce variations. Consequently, offspring inherit novel allele combinations, increasing the overall genetic variability within the biological population.

40. (C) Testis → Vas deferens → Urethra
Sperm cells are manufactured in the seminiferous tubules of the testes before moving to the epididymis for maturation and storage. Upon ejaculation, mature sperm travel upward through the vas deferens, enter the ejaculatory duct, and finally exit the male body through the urethra, which serves as the final common channel.

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allowing maximum passage of vital nutrients and oxygen from the maternal bloodstream into foetal circulation.

21. (C) 9 months
The human gestation period refers to the total duration of intrauterine development from fertilization until childbirth. In human pregnancy, this period spans approximately forty weeks, or roughly nine calendar months. During this timeframe, a single fertilized zygote undergoes complex differentiation and organogenesis to form a fully developed newborn infant.

22. (C) Parturition
Parturition is the physiological term used to describe the act of giving birth, marking the conclusion of pregnancy. It involves the expulsion of a fully developed foetus from the mother's uterine cavity into the external environment through the dilated birth canal, driven by coordinated uterine muscular contractions and hormonal signals.

23. (D) Rhythmic contractions of the muscles in the uterus
Childbirth, or parturition, is primarily initiated and sustained by strong, regular contractions of the smooth muscle layer of the uterine wall, known as the myometrium. Stimulated by the hormone oxytocin, these rhythmic uterine contractions gradually dilate the cervix and exert pressure to push the foetus out through the vagina.

24. (A) Condoms
Barrier methods of contraception physically prevent male sperm from reaching the female egg during sexual contact. A condom is a thin sheath worn over the erect penis or inside the vagina that traps ejaculated seminal fluid, thereby blocking sperm movement while simultaneously reducing the risk of transmitting sexually transmitted infections.

25. (B) I, II and III only
Contraceptive techniques utilize various biological mechanisms to prevent unintended pregnancy. Intrauterine devices prevent implantation, oral pills adjust systemic hormones to halt ovulation, and surgical procedures permanently block gamete transport pathways. Crucially, physical barrier methods like condoms remain unique among contraceptives because they also offer substantial protection against STDs.

26. (C) They alter hormonal balances to prevent egg release
Oral contraceptive pills contain synthetic hormones, typically combinations of oestrogen and progesterone, that alter the endocrine feedback system in females. By maintaining elevated levels of these steroids, the pills suppress the secretion of pituitary gonadotropins, thereby inhibiting monthly ovulation and preventing the release of mature eggs from the ovaries.

27. (D) Vasectomy
Vasectomy is a safe, permanent surgical procedure performed on males as a method of birth control. During a vasectomy, a small segment of each vas deferens is cut, tied, or sealed off. This prevents sperm produced in the testes from mixing into the ejaculated fluid during sexual activity.

28. (A) Fallopian tube
Tubectomy is a permanent surgical method of contraception performed on females. The procedure involves severing, tying, or clamping both fallopian tubes. By blocking these ducts, the path between the ovaries and the uterus is permanently closed, preventing released eggs from meeting sperm and thereby obstructing fertilization in the reproductive tract.

29. (D) HIV-AIDS
Human Immunodeficiency Virus, commonly abbreviated as HIV, is a viral pathogen transmitted through sexual contact, infected blood products, or maternal-foetal exposure. HIV infects and gradually destroys crucial immune cells, specifically CD4 T-lymphocytes, eventually leading to Acquired Immunodeficiency Syndrome, a severe condition characterized by progressive immune system failure.

30. (B) Syphilis
Syphilis is a sexually transmitted bacterial disease caused by the spirochete bacterium Treponema pallidum. It spreads primarily through direct contact with infectious sores during sexual activity. If untreated, syphilis progresses through distinct clinical stages, potentially causing long-term damage to the cardiovascular, nervous, and systemic tissue systems of the body.

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mature gamete production commences, and secondary sexual characteristics develop under the active endocrine regulation of key sex hormones like testosterone, oestrogen, and progesterone.

52. (B) Growth of body hair in axillary and pubic areas
During puberty, elevated levels of adrenal and gonadal steroid hormones trigger secondary sexual changes in both males and females. While voice deepening occurs in males and breast development in females, the appearance of coarse body hair in the axillary armpit and pubic regions represents a common shared pubertal characteristic.

53. (C) Semen
Semen is the fluid ejaculated from the male reproductive tract during sexual release. It consists of mature sperm cells produced in the testes suspended within seminal plasma. Seminal plasma is synthesized and secreted by male accessory glands, predominantly the seminal vesicles and the prostate gland, providing nutrients and alkaline protection.

54. (B) During fetal development
Unlike males who produce sperm continuously after puberty, human females initiate gametogenesis during early embryonic development in the womb. Oogonia undergo mitosis and enter meiosis to form primary oocytes before birth. These oocytes remain arrested in prophase I until puberty, when hormonal cycles resume their development one by one.

55. (B) II and III only
At birth, female ovaries already contain all primary oocytes inside dormant follicles, with no new eggs formed thereafter. Following puberty, cyclic hormonal stimulation causes typically one mature egg to be released each month during ovulation. The fallopian tube then captures this egg and provides a passage toward the uterus.

56. (D) The placenta
Metabolic activities within the growing embryo generate metabolic waste products such as urea, uric acid, and carbon dioxide. Because embryonic excretory organs are not fully developed, these metabolic wastes diffuse across thin embryonic capillary walls into the placenta, where maternal blood absorbs and subsequently eliminates them through the mother's kidneys.

57. (B) The head
A mature human sperm cell is structured into a head, middle piece, and tail. The oval-shaped head contains a highly condensed haploid nucleus storing twenty-three paternal chromosomes. It is capped by the acrosome, a specialized vesicle filled with hydrolytic enzymes designed to dissolve the protective coating surrounding the egg.

58. (C) Swimming towards the egg
The tail of a human sperm cell is a long flagellum driven by microtubule structural arrangements. Powered by ATP generated by abundant mitochondria packed in the sperm's middle piece, the tail undergoes whip-like undulating movements that propel the sperm forward through female reproductive fluids toward the fallopian tube.

59. (D) HIV-AIDS
Barrier contraceptives like latex condoms provide a physical shield during sexual intercourse that prevents direct contact with bodily fluids and mucosal membranes. This physical barrier blocks the transmission of viral pathogens, effectively reducing the risk of contracting sexually transmitted infections such as Human Immunodeficiency Virus, which causes AIDS.

60. (C) It acts as an IUD to prevent implantation
The Copper-T is a small T-shaped intrauterine device placed inside the uterine cavity by healthcare professionals. It slowly releases copper ions that disrupt sperm motility and fertilization. Additionally, it causes a mild localized inflammatory response in the endometrium, preventing a fertilized blastocyst from successfully implanting into the uterine wall.

61. (D) Female foeticide
A declining female-to-male sex ratio in a population reflects a critical demographic imbalance often caused by sex-selective abortion or female foeticide. The illegal misuse of prenatal diagnostic techniques to determine foetal gender, combined with persistent societal preferences for male offspring, leads to the systematic termination of female foetuses.

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ANSWERS

1. (B) The formation of new offspring through the fusion of male and female gametes
Sexual reproduction in humans is a biological process requiring two distinct parents, each contributing haploid sex cells known as gametes. The male gamete, called sperm, unites with the female gamete, called an egg or ovum, in a process known as fertilization. This fusion combines genetic material to create a single diploid zygote.

2. (D) To produce sperm and secrete testosterone
The testes are the primary male reproductive organs located outside the main abdominal cavity. They perform two key biological functions essential for male reproduction: spermatogenesis, which is the production of male gametes or sperm, and endocrine secretion, specifically producing testosterone. Testosterone drives the development of male secondary sexual characteristics and maintains reproductive functions.

3. (A) To maintain a temperature lower than the normal body temperature for sperm formation
Spermatogenesis, the biological process of sperm cell production, requires a temperature that is approximately two to two and a half degrees Celsius lower than normal human core body temperature. The scrotum acts as a thermoregulatory pouch located outside the abdominal cavity, holding the testes at an optimal temperature necessary for healthy sperm development.

4. (C) Vas deferens
The vas deferens is a thick-walled muscular tube in the male reproductive system that connects the epididymis to the ejaculatory duct and urethra. During male reproductive activity, rhythmic muscular contractions along the vas deferens transport mature sperm upward from the scrotal sac into the pelvic cavity towards the urethra for eventual release.

5. (A) They nourish sperm and make their transport easier.
The prostate gland and seminal vesicles are male accessory glands that secrete seminal plasma into the reproductive tract. This fluid contains fructose, enzymes, and alkaline substances that nourish sperm cells, protect them against acidity, provide energy for motility, and create a liquid medium that facilitates smooth transport through the urethra.

6. (D) Ovary
The ovaries are the primary female reproductive glands situated in the lower pelvic cavity on either side of the uterus. They are responsible for producing female gametes, known as ova or eggs, through the process of oogenesis. Additionally, the ovaries secrete major sex hormones, including oestrogen and progesterone, throughout female life.

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7. (B) Fallopian tube
The fallopian tube, also known as the oviduct, is a muscular duct that connects the ovary to the uterus. Following ovulation, the released mature egg enters the fallopian tube. Fertilization typically occurs in the ampullary region of this tube when a viable sperm cell successfully penetrates the ovum's outer layer.

8. (C) It serves as the site for embryo implantation and development.
The uterus, or womb, is a hollow, muscular organ in the female pelvic cavity designed to support embryonic and foetal development. After fertilization in the fallopian tube, the developing blastocyst travels into the uterus, where it implants into the inner nutrient-rich lining, remaining anchored throughout pregnancy until childbirth occurs.

9. (D) It breaks down and exits the vagina as blood and mucus.
If fertilization of the released egg does not take place, progesterone levels drop rapidly toward the end of the female monthly cycle. As a result, the vascularized inner uterine lining, known as the endometrium, degrades and breaks down. It is shed through the vaginal opening along with blood and mucus during menstruation.

72. (B) Folic acid
Folic acid, also known as Vitamin B9, plays a vital role in cellular division, DNA synthesis, and early neural development. Adequate maternal intake of folic acid prior to conception and during early pregnancy significantly reduces the risk of severe congenital neural tube defects, such as spina bifida, in the developing embryo.

73. (C) Infertility
Infertility is medically defined as the inability of a couple to achieve successful biological conception after twelve consecutive months of regular, unprotected sexual intercourse. It can stem from various physiological, endocrine, structural, or genetic factors affecting either the male or female reproductive systems, requiring clinical evaluation and specialized intervention.

74. (D) Painless sores (chancres) on the genitals and rashes
Syphilis is a sexually transmitted bacterial infection that progresses through distinct clinical stages. Primary syphilis is classically characterized by the appearance of a single or multiple firm, painless infectious sores called chancres at the site of infection, followed later by secondary skin rashes and systemic symptoms if left untreated.

75. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
The foetal portion of the placenta features numerous finger-like chorionic villi extending into maternal blood spaces. These villi significantly expand the surface area across which metabolic exchange occurs, allowing essential glucose, amino acids, and oxygen to pass efficiently from maternal blood into foetal circulation. Thus, both statements are true.

76. (C) Fallopian tube
Following successful fertilization in the ampulla of the fallopian tube, the newly formed zygote immediately begins a series of rapid mitotic cell divisions known as cleavage. As these cleaving blastomeres divide to form a morula, hair-like cilia and muscular contractions propel the developing embryo along the fallopian tube toward the uterus.

77. (B) Vagina
During childbirth, the vagina forms the lower portion of the continuous birth canal alongside the dilated cervix. This elastic, muscular canal extends from the uterine neck to the external genital opening, expanding significantly under hormonal influence to facilitate the safe passage and expulsion of the baby during parturition.

78. (C) They protect against STDs
Oral contraceptive pills consist of synthetic hormones that manipulate the endocrine axis to suppress ovulation and prevent pregnancy. Although highly effective at birth control when taken consistently, oral pills act entirely within internal endocrine pathways and do not form a physical barrier, offering zero protection against sexually transmitted infections.

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79. (D) When major body parts are identifiable
In human prenatal development, the growing organism is classified as an embryo during the initial eight weeks following fertilization. From the ninth week onward, once essential organ systems have formed and distinct physical structures such as head, limbs, and digits become recognizable, it is medically referred to as a foetus.

80. (A) II, I, IV, III
Human reproduction follows an established chronological sequence of biological events. First, gametogenesis produces mature haploid sperm and egg cells. Fertilization occurs when a sperm unites with an egg, resulting in zygote formation. Finally, after initial cellular divisions, the blastocyst travels to the uterus for successful implantation into the uterine lining.

81. (B) Spermatogenesis
Spermatogenesis is the biological process by which male germ cells undergo division and differentiation within the seminiferous tubules of the testes to produce haploid sperm cells. Initiated during puberty under gonadotropic stimulation, spermatogenesis continues continuously throughout a male's adult life, generating millions of motile gametes daily.

82. (D) Epididymis
The epididymis is a tightly coiled tubular structure attached along the posterior surface of each testis. Immature sperm formed in the seminiferous tubules pass into the epididymis, where they are stored temporarily for several weeks to mature, acquire motility, and gain the capacity for fertilizing an egg prior to ejaculation.

posterior pituitary gland during labor. It acts directly on uterine smooth muscle receptors, stimulating powerful, rhythmic contractions of the myometrium. A positive feedback loop amplifies oxytocin release, driving progressive cervical dilation and birth expulsion.

164. (B) To prevent reproductive tract infections
Regular personal hygiene and thorough washing of the external genital region remove accumulated sweat, dead skin, smegma, and vaginal secretions. Maintaining cleanliness prevents opportunistic bacterial and fungal overgrowth, drastically lowering the incidence of painful urinary tract infections, vaginitis, urethritis, and broader pelvic inflammatory conditions in both males and females.

165. (B) Blocking the sperm exit pathway
A vasectomy is a male surgical sterilization procedure that involves severing and sealing the vas deferens tubes in the scrotum. While testicular sperm production and hormonal secretion continue normally, blocking these transport pathways physically prevents sperm from entering ejaculated semen, ensuring that ejaculate contains no sperm to fertilize eggs.

166. (C) AIDS
Acquired Immunodeficiency Syndrome is caused by Human Immunodeficiency Virus infection, which targets helper T-lymphocytes. The progressive depletion of these central immune cells severely impairs overall host immunity, rendering the infected individual vulnerable to life-threatening opportunistic infections, rare malignancies, and severe systemic health complications that normal immune systems easily prevent.

167. (A) The female body is not yet fully mature for pregnancy
Early marriage and teenage pregnancy pose substantial biological health risks because an adolescent female's body and reproductive organs are not yet fully mature to handle gestation and birth delivery. Young mothers face increased risks of severe anaemia, pre-eclampsia, obstructed labor, maternal mortality, and delivering low-birth-weight or premature infants.

168. (B) Ovary → Fallopian tube → Uterus → Vagina
The pathway of an unfertilized egg begins when it is released from the ovary during ovulation. Captured by fimbriae, the egg travels through the fallopian tube toward the uterus. Remaining unfertilized, it enters the uterine cavity and is eventually discharged through the vagina along with menstrual flow.

169. (C) It receives sperm and acts as the birth canal
The vaginal canal is a distensible muscular tube in the female reproductive tract that performs key functional roles. During sexual intercourse, it receives deposited semen and facilitates sperm movement toward the cervix. Furthermore, during childbirth, the vagina expands significantly to serve as the birth canal for delivering the foetus.

170. (A) P-3, Q-4, R-2, S-1
Male reproductive anatomy features distinct functional structures. The scrotum is a skin pouch that thermoregulates testicular temperature. Testes are oval gonads producing sperm and testosterone. The vas deferens is a muscular duct conveying sperm out of the scrotal sac, and the urethra acts as a common passage for urine and semen.

171. (A) Ensure maturity and better reproductive health
Minimum legal age limits for marriage are established to safeguard physical, mental, and reproductive health. Delaying marriage ensures that individuals achieve emotional maturity and full physical development, reducing health risks associated with early teenage pregnancy, lowering infant and maternal mortality, and encouraging complete educational and social development before parenthood.

172. (B) Seminal vesicle
The seminal vesicles are paired male accessory glands that produce a thick, fluid secretion contributing significantly to semen volume. This seminal fluid is rich in fructose, prostaglandins, and proteins. Fructose provides the primary energy source needed by sperm mitochondria to synthesize ATP for flagellar propulsion through the female tract.

173. (B) 46 in somatic cells, 23 in gametes
Normal human somatic body cells are diploid, carrying forty-six chromosomes arranged in twenty-three matching homologous pairs. During gametogenesis, meiotic cell division reduces the genetic material by half. As a result, mature gametes—sperm and egg cells—are haploid, each

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suppress menstrual shedding. Consequently, the endometrium remains fully intact, highly vascularized, and thickened to nourish and support the foetus throughout pregnancy.

93. (A) One set of maternal and one set of paternal chromosomes
Human somatic cells are diploid, containing forty-six chromosomes. Gametes produced through meiosis are haploid, carrying twenty-three chromosomes each. During fertilization, the haploid maternal nucleus of the ovum unites with the haploid paternal nucleus of the sperm, creating a diploid zygote that possesses one maternal set and one paternal set.

94. (D) It aids sperm transport and provides nutrition
Secretions from the seminal vesicles and prostate gland mix with sperm to form semen. This fluid contains fructose, which serves as an energy source for sperm motility, along with alkaline compounds that neutralize vaginal acidity. This protective fluid medium facilitates smooth transport through the male and female reproductive tracts.

95. (B) II only
Sexually transmitted diseases are infections spread through sexual contact. Syphilis is caused by the bacterium Treponema pallidum, making it a bacterial infection rather than a viral one. Statement two is incorrect because it falsely classifies Syphilis as viral, while statements regarding transmission routes and condom barrier protection are correct.

96. (B) Ovulation
Ovulation is the specific physiological process in the ovarian cycle where a mature Graafian follicle ruptures at the surface of the ovary. Induced by a sudden surge in luteinizing hormone from the anterior pituitary, this event releases the secondary oocyte into the peritoneal cavity to be gathered by fallopian fimbriae.

97. (D) It prevents gametes from meeting in the fallopian tube
Tubectomy is a permanent surgical sterilization technique in females that involves cutting, tying, or sealing the fallopian tubes. Although ovarian follicle development and monthly ovulation continue normally, blocking the tubes prevents the released egg from meeting sperm cells, thereby physically obstructing fertilization in the female tract.

98. (A) Because it serves as a passage for both urine and semen
In human males, the urethra acts as a shared urogenital channel extending from the urinary bladder through the penis. It transports urine during excretion from the urinary system and conveys seminal fluid containing sperm during ejaculation, making it a common duct for both urinary and reproductive functions.

99. (C) In Vitro Fertilisation
Assisted reproductive technologies comprise medical procedures utilized to treat infertility. In Vitro Fertilisation is a primary example of these technologies, involving the laboratory fertilization of extracted eggs by sperm outside the body, followed by the transfer of the resulting early embryo into the female uterus to establish pregnancy.

100. (B) Anaemia
Pregnant women require increased dietary iron intake because maternal blood volume expands significantly to supply oxygen to the growing foetus and placenta. Insufficient iron intake severely impairs haemoglobin synthesis, leading to maternal anaemia, which increases the risk of maternal fatigue, low birth weight, premature delivery, and post-partum surgical complications.

101. (C) Puberty
Puberty is the distinct developmental stage during human adolescence characterized by rapid physical growth, complex hormonal changes, and the full maturation of primary reproductive organs. Under the influence of pituitary and gonadal hormones, gonads begin generating functional gametes, endocrine glands secrete sex hormones, and secondary sexual characteristics develop fully.

102. (B) Onset of menstruation
Puberty involves major physical changes driven by sex steroid hormones in both genders. While body hair growth and skin gland activity occur in both males and females, the onset of menstruation, or menarche, is exclusive to females, signifying that cyclic ovarian function and uterine preparations for potential reproduction have officially commenced.

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103. (C) 14
In a standard twenty-eight-day female menstrual cycle, day one corresponds to the start of menstrual bleeding. Driven by a surge in luteinizing hormone, ovulation typically occurs near the midpoint of the cycle, around day fourteen, when the mature follicle ruptures to release an egg into the fallopian tube.

104. (A) The acrosome
The acrosome is a specialized cap-like organelle located over the anterior region of the sperm head. Derived from the Golgi apparatus, it contains digestive hyaluronidase and proteolytic enzymes that are released during the acrosome reaction, allowing the sperm to penetrate the outer protective layers of the egg cell.

105. (A) I, II and III only
The menstrual cycle is a repeating reproductive process in human females lasting about twenty-eight days. It involves monthly egg release and uterine lining shedding, and it pauses during pregnancy. However, menstruation does not continue indefinitely; it permanently ceases between forty-five and fifty-five years of age during menopause.

106. (A) Haploid (containing half the chromosome set)
Gametes are specialized reproductive sex cells—sperm in males and ova in females—produced through meiotic cell division. Meiosis halves the species chromosome count, yielding haploid cells containing twenty-three individual chromosomes. When these haploid gametes unite during fertilization, the resulting zygote inherits forty-six chromosomes, successfully restoring the full diploid genetic complement.

107. (B) Sperm are small and motile, whereas eggs are large and non-motile.
Male and female gametes exhibit marked structural adaptations. Human sperm are microscopic, streamlined, highly motile cells equipped with a flagella tail designed for rapid swimming. In contrast, female ova are large, spherical, non-motile cells containing dense cytoplasm and nutrient reserves necessary to sustain early embryonic growth after fertilization.

108. (B) To improve maternal-child health and regulate population
National family planning initiatives aim to comprehensively educate communities regarding reproductive health, effective contraception, and child spacing. Regulating birth timing reduces risks associated with unintended pregnancies, significantly lowers maternal and infant mortality, promotes overall family well-being, and aligns national population growth with available national economic and natural resources.

109. (D) Formation of a zygote
Fertilization occurs when a male haploid sperm cell successfully penetrates and fuses with a female haploid ovum within the fallopian tube. The immediate biological result of this nuclear fusion is the creation of a single diploid cell called a zygote, which subsequently undergoes rapid divisions to form an embryo.

110. (C) Vagina
The vagina is a distensible muscular tube in the female reproductive tract extending from the vulva to the uterine cervix. During sexual intercourse, the vagina receives the male penis and deposited semen, acting as a canal for sperm transport upward into the uterus toward the fallopian tubes.

111. (A) Corpus luteum
Following ovulation, the ruptured Graafian follicle inside the ovary undergoes structural transformation into a temporary endocrine structure known as the corpus luteum. Stimulated by luteinizing hormone, the corpus luteum secretes significant quantities of progesterone and oestrogen to prepare and maintain the uterine lining for potential embryo implantation.

112. (B) Immune system
Human Immunodeficiency Virus directly targets and infects key structural components of the human immune system, specifically CD4 positive helper T-lymphocytes. As the virus replicates, it progressively destroys these crucial immune cells, severely weakening host immunity and leaving the infected individual vulnerable to life-threatening opportunistic infections and secondary malignancies.

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113. (C) Condoms
Condoms are physical barrier devices worn during sexual intercourse to prevent direct contact between genital tissues and fluids. By physically blocking semen transfer, condoms effectively prevent unwanted pregnancy and simultaneously offer robust protection against the transmission of sexually transmitted pathogens, including HIV, bacterial gonorrhoea, syphilis, and herpes simplex virus.

114. (D) First menstrual cycle in a female
Menarche refers to the very initial occurrence of menstruation in human females, marking a pivotal biological milestone during pubertal development. Occurring typically between eleven and fifteen years of age, menarche signifies that pituitary gonadotropins have successfully stimulated ovarian follicular development, ovulation, and cyclic shedding of the inner uterine lining.

115. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Vasectomy is a permanent surgical birth control method in males. The procedure involves severing and sealing the vas deferens tubes, which prevents sperm produced in the testes from reaching the ejaculatory ducts. Consequently, ejaculated semen contains no sperm, making vasectomy an exceptionally effective contraceptive choice. Both statements are accurate.

116. (B) They block sperm from meeting the egg
Fertilization naturally takes place inside the fallopian tube, where ascending sperm meet the released egg. Physical blockages in the fallopian tubes, caused by pelvic infections or scarring, prevent sperm from reaching the ovum. Because gametes cannot interact, natural conception is blocked, making assisted reproductive technologies like IVF necessary.

117. (C) The early embryo
In Vitro Fertilisation involves combining extracted mature eggs and sperm in a specialized laboratory culture dish. Once fertilization succeeds, the resulting single-celled zygotes are incubated as they undergo initial cell divisions. After developing into early embryos, typically at the cleavage or blastocyst stage, they are transferred into the uterus.

118. (D) Amniotic fluid
Amniotic fluid is a vital protective liquid contained within the membranous amniotic sac surrounding the developing foetus inside the uterus. It cushions the foetus against mechanical external shocks, maintains a constant thermal environment, prevents structural adhesions, and facilitates symmetrical musculoskeletal growth and foetal movement throughout the gestation period.

119. (B) Pelvic inflammatory infections
Inadequate menstrual hygiene, such as using unsterilized cloths or neglecting regular personal washing, fosters rapid bacterial multiplication near the vaginal opening. Pathogens can ascend through the cervix into the uterus and fallopian tubes, triggering severe pelvic inflammatory infections that cause chronic pain, scarring, and potential long-term infertility.

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120. (A) Zygote → Cleavage → Blastocyst → Implantation
Human embryonic development follows a precise sequence of physiological events. Fertilization of the ovum by a sperm forms a single-celled zygote. The zygote undergoes rapid mitotic divisions called cleavage, forming a hollow sphere of cells known as a blastocyst, which subsequently embeds into the uterine endometrium during implantation.

121. (C) Cushion and protect the foetus
The amniotic sac is a durable fluid-filled membrane surrounding the developing embryo inside the womb. Filled with amniotic fluid, its principal physiological function is to act as a shock absorber, shielding the foetus from external mechanical physical shocks, regulating temperature, and preventing embryonic tissue from adhering to surrounding membranes.

122. (D) Growth of a beard and moustache
Secondary sexual characteristics develop during puberty under the influence of gonadal steroid hormones. In human males, increased testosterone secretion stimulates the prominent appearance of facial hair, including a beard and moustache, along with larynx enlargement causing voice deepening, chest broadening, and increased musculoskeletal mass across the body.

143. (C) Vas deferens
The human female reproductive system comprises the ovaries, fallopian tubes, uterus, cervix, and vagina. In contrast, the vas deferens is an essential component of the male reproductive system, functioning as a long muscular tube that transports mature sperm from the epididymis to the ejaculatory duct prior to discharge.

144. (B) Father, as he contributes an X or Y chromosome
Human sex determination is genetically dictated by paternal sex chromosomes. Females possess two X chromosomes, producing eggs that carry only X chromosomes. Males possess one X and one Y chromosome, producing sperm carrying either X or Y. Fertilization by an X-bearing sperm produces a female, while a Y-bearing sperm yields a male.

145. (B) I, II and III only
In Vitro Fertilisation involves fertilizing extracted mature eggs with sperm in laboratory glassware outside the maternal body, which is why it is colloquially termed test-tube baby technology. It helps couples overcome blocked tubes or male factor infertility. However, statement four is false because foetal development occurs inside the maternal uterus.

146. (C) Vocal deepening and Adam's apple growth
During male puberty, increased secretion of testosterone by testicular Leydig cells stimulates secondary sexual development. Key structural changes driven by testosterone include larynx enlargement, vocal cord lengthening leading to voice deepening and Adam's apple prominence, facial and body hair growth, and overall skeletal and muscle growth spurts.

147. (A) Maturation increases curiosity and risk of STDs
Adolescence involves significant physical, emotional, and hormonal changes that accompany sexual maturation. Increased curiosity, emotional vulnerability, and exposure to social pressures, combined with a lack of adequate accurate information regarding safe practices, heighten the risk of premature sexual activity, unintended adolescent pregnancies, and exposure to sexually transmitted infections.

148. (B) To capture the released ovum
The infundibulum at the distal end of each fallopian tube features slender, finger-like mucosal projections called fimbriae. During ovulation, these fimbriae sweep over the ovarian surface, creating fluid currents and physical contact that capture the released ovum from the peritoneal cavity and direct it into the fallopian tube.

149. (C) Hysterectomy
Hysterectomy is a major surgical procedure involving the complete removal of the uterus. Performed to treat medical conditions such as uterine fibroids, severe endometriosis, heavy abnormal bleeding, or reproductive cancers, the procedure results in the permanent cessation of menstruation and leaves the individual incapable of carrying a pregnancy.

150. (C) Copper-T (IUD)
An intrauterine device like the Copper-T is an ideal reversible contraceptive choice for spacing children over several years. Inserted into the uterus, it provides continuous, highly effective protection against pregnancy for three to ten years. When the couple decides to conceive, healthcare professionals can easily remove the device, restoring fertility.

151. (B) Calcium
Dietary calcium is essential during pregnancy to meet the physiological demands of the growing foetus, which requires substantial calcium for developing its skeletal bone matrix and teeth. Adequate maternal calcium intake protects the mother's bone density, preventing mineral depletion and reducing the risk of maternal osteoporosis later in life.

152. (B) PCOS causing irregular ovulation
Polycystic Ovary Syndrome is a common endocrine disorder in women that causes hormonal imbalances, elevated androgens, and multiple small ovarian cysts. These internal hormonal disruptions impair normal follicular development, leading to irregular ovulation or complete anovulation, which represents a leading cause of female infertility by preventing regular egg release.

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133. (B) Meiosis
Meiosis is a specialized form of nuclear cell division occurring exclusively in germ line cells during gametogenesis. Comprising two successive nuclear divisions following one round of DNA replication, meiosis reduces the chromosome number by half, converting diploid stem cells into haploid gametes containing twenty-three single chromosomes each.

134. (B) Ciliary beating and muscular contractions in the tube
Following fertilization, the non-motile zygote travels along the fallopian tube toward the uterine cavity. Transport is driven by the coordinated, rhythmic beating of microscopic hair-like cilia on the inner mucosal lining combined with smooth muscle peristaltic contractions of the fallopian tube wall, safely propelling the dividing embryo forward.

135. (C) III only
The placenta is a specialized organ embedded in the uterine wall that facilitates gas exchange, nutrient delivery, and waste removal for the developing embryo. However, the placental barrier is incomplete; it cannot stop all harmful pathogens, alcohol, nicotine, or certain medications from entering foetal blood, making statement three incorrect.

136. (B) Its mitochondria supply energy for sperm motility
The middle piece of a human sperm cell contains a dense spiral arrangement of mitochondria wrapped around the central axial filament. These mitochondria synthesize metabolic adenosine triphosphate via aerobic respiration, providing the continuous energy required to drive flagellar tail movements and propel the sperm toward the egg.

137. (C) Spermicides
Spermicides represent a chemical method of contraception available as gels, foams, creams, or suppositories. Applied inside the vagina prior to sexual contact, these chemical agents contain active substances like nonoxynol-9 that disrupt sperm cell membranes, immobilizing or destroying sperm to prevent them from reaching and fertilizing an egg.

138. (B) To prevent female foeticide
The Pre-Conception and Pre-Natal Diagnostic Techniques Act was enacted in India to regulate diagnostic technologies and strictly prohibit sex determination of foetuses. By banning the misuse of ultrasound for gender detection, the law aims to stop sex-selective female abortions, safeguard female foetuses, and correct declining sex ratios nationwide.

139. (D) HIV-AIDS
Acquired Immunodeficiency Syndrome is caused by the Human Immunodeficiency Virus, which targets helper T-lymphocytes essential for immune response coordination. As the viral infection reduces immune cell counts, the body's defensive capabilities crumble, leaving the individual susceptible to opportunistic bacterial, fungal, and viral infections that normally cause minimal harm.

140. (C) Pre-eclampsia
Monitoring blood pressure during routine antenatal check-ups is vital for detecting pre-eclampsia, a serious pregnancy complication characterized by high blood pressure and protein in the urine. Uncontrolled pre-eclampsia can impair placental blood flow, restrict foetal growth, and lead to maternal organ damage or life-threatening seizures during late gestation.

141. (B) Sterility from impaired sperm production
Cryptorchidism is the medical condition where one or both testes fail to descend into the scrotum before birth, remaining inside the abdomen. Because internal body temperature is too high for healthy spermatogenesis, uncorrected cryptorchidism causes irreversible damage to seminiferous tubules, resulting in impaired sperm production and sterility.

142. (B) One large functional egg and smaller polar bodies
Oogenesis is the specialized cellular process of egg development in females. Unequal cytoplasmic division during meiotic steps produces one large, nutrient-rich functional ovum containing the majority of cytoplasm needed to support early embryonic growth, along with three smaller degenerate cells called polar bodies that eventually break down completely.

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83. (B) Cervix
The cervix is the narrow, thick-walled muscular neck located at the inferior portion of the uterus that connects the uterine cavity to the vagina. It contains a central canal lined with glands that secrete cervical mucus, acting as a portal for sperm entry and expanding significantly during childbirth to allow delivery.

84. (C) Sperm are motile while eggs are non-motile
Human gametes display significant functional and structural differences. Sperm are tiny, streamlined cells equipped with a flagellar tail that enables active propulsion through fluids to reach the egg. In contrast, ova are large, nutrient-rich cells that lack self-locomotion mechanisms, relying on ciliary currents to travel along the fallopian tube.

85. (A) Progesterone
Progesterone is a vital steroid hormone synthesized by the corpus luteum following ovulation and subsequently by the placenta during gestation. It maintains the vascular, highly secretory state of the uterine endometrium, effectively preventing uterine contractions and menstrual shedding, thereby preserving a stable environment necessary for supporting continuous healthy pregnancy.

86. (B) Oral pills
Oral contraceptive pills contain synthetic preparations of oestrogen and progestin that artificially alter systemic hormone concentrations to inhibit ovulation. Because these pills modify normal endocrine feedback loops, potential side effects include hormonal imbalances that manifest as spotting, irregular menstrual bleeding, nausea, breast tenderness, or mild mood fluctuations.

87. (C) Low sperm count
Male infertility can result from various physiological factors that impair reproductive capacity. Oligospermia, or low sperm count, occurs when ejaculated semen contains significantly fewer sperm than normal. Having fewer viable sperm reduces the statistical likelihood of sperm successfully ascending the female tract and fertilizing a mature egg cell.

88. (D) Regular antenatal check-ups and institutional delivery
Safe motherhood initiatives focus on reducing maternal and infant mortality through comprehensive healthcare practices. Key components include scheduled antenatal clinical visits to monitor foetal development, proper maternal nutrition and tetanus immunization, and delivering newborn babies in hygienic healthcare institutions supervised by trained medical personnel during labor and delivery.

89. (C) Increased strain on essential food, housing, and healthcare
Uncontrolled human population growth creates severe socioeconomic and environmental pressures across global communities. Rapid population expansion outpaces infrastructure development, leading to overexploitation of natural resources, severe strain on public healthcare systems, overcrowding in housing, food shortages, educational deficits, and increased environmental degradation, thereby compromising general overall living standards.

90. (A) P-1, Q-2, R-3, S-4
Sexually transmitted infections arise from diverse microbial pathogens. Gonorrhoea is caused by Neisseria gonorrhoeae bacteria, while Syphilis is caused by Treponema pallidum bacteria. Conversely, Human Immunodeficiency Virus causes severe HIV-AIDS, and Human Papillomavirus causes genital warts, illustrating that STDs can stem from either bacterial or viral infectious agents.

91. (B) Generates genetic variation for adaptation and survival
Sexual reproduction offers a significant evolutionary advantage over asexual modes by generating genetic variation in offspring. Meiotic recombination and the random fusion of diverse parental gametes produce novel genetic combinations. This genetic diversity enables populations to adapt effectively to changing environments, resist disease outbreaks, and enhance long-term survival.

92. (D) It remains intact to support the developing foetus
The endometrium is the functional inner mucosal lining of the uterus. Upon successful fertilization and blastocyst implantation, rising progesterone levels secreted by the corpus luteum and placenta

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153. (B) Surface changes on the egg block additional sperm
Monospermy is ensured by cortical reactions triggered upon entry of the first sperm cell. The egg membrane depolarizes, and cortical granules release enzymes into the perivitelline space. This hardens the surrounding zona pellucida and alters surface receptors, creating a fast and slow block that prevents polyspermy by additional sperm cells.

154. (C) No, it only prevents pregnancy, not STDs
The Copper-T is an intrauterine device designed specifically to prevent unintended pregnancy by disrupting sperm function and blocking implantation inside the uterus. However, because it does not create a physical barrier between mucosal surfaces during intercourse, it offers no protection against the transmission of viral or bacterial sexually transmitted infections.

155. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Under the cyclic influence of oestrogen and progesterone, the uterine endometrium thickens and becomes vascularized every month. This physiological preparation creates a soft, nutrient-rich tissue bed designed to receive and nourish an implanted embryo. Because the reason correctly explains the underlying biological purpose of uterine thickening, both statements are true.

156. (C) Umbilical cord
The umbilical cord is a vascular, flexible tube connecting the foetus to the placenta during pregnancy. Enclosing two umbilical arteries and one umbilical vein within Wharton's jelly, it transports oxygen and nutrients from the placenta to the foetus while carrying foetal metabolic wastes back to the placenta for disposal.

157. (B) Cervical dilation and uterine contractions
Normal delivery, or parturition, is preceded by progressive labor stages. Driven by oxytocin release, strong rhythmic uterine smooth muscle contractions gradually efface and dilate the cervix to ten centimeters. Cervical dilation combined with continuous uterine contractions pushes the baby down the birth canal immediately before successful expulsion takes place.

158. (B) The start of menstrual bleeding
Day one of the human female menstrual cycle is universally defined by the onset of overt menstrual bleeding. This bleeding marks the breakdown and shedding of the unneeded inner uterine lining following the degeneration of the corpus luteum when fertilization has not occurred during the preceding reproductive cycle.

159. (B) Ectopic pregnancy
An ectopic pregnancy occurs when a fertilized egg implants and develops outside the main uterine cavity, most frequently within the fallopian tube. Because extrauterine tissues cannot support embryonic growth, ectopic pregnancies pose severe risks of maternal internal hemorrhage, tubal rupture, and life-threatening medical emergencies requiring immediate clinical surgical intervention.

160. (A) III, II, IV, I
Following menstruation, the female cycle progresses in a strict sequence. First, rising oestrogen triggers thickening of the uterine lining. Next, ovulation releases an egg from the ovary. The egg travels through the fallopian tube to the uterus. Finally, if unfertilized, falling hormone levels cause the uterine lining to break down.

161. (B) Oogenesis
Oogenesis is the complex biological process of female gamete development occurring within the ovaries. Initiated during embryonic development and resumed after puberty, oogenesis involves meiotic cell divisions that transform oogonia into mature haploid ova while producing polar bodies, ultimately yielding functional female sex cells for potential fertilization.

162. (B) Colostrum supplies key protective antibodies
Breastfeeding immediately after birth provides the infant with colostrum, the thick yellowish milk produced by mammary glands during early lactation. Colostrum is exceptionally rich in essential nutrients and crucial maternal antibodies, particularly Secretory Immunoglobulin A, which coats the infant's gut mucosa, providing immediate passive immunity against infectious diseases.

163. (C) Oxytocin
Oxytocin is a vital peptide hormone synthesized in the hypothalamus and released by the

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123. (B) Menstruation
Menstruation is the periodic physiological shedding of the vascular inner uterine lining, or endometrium, in females when fertilization does not occur. Decreasing levels of progesterone cause the vascular lining and its capillaries to break down, resulting in blood, tissue debris, and unfertilized mucosal fluid discharging through the vagina.

124. (B) It promotes the thickening of the uterine lining
Oestrogen is a primary female sex hormone synthesized by developing ovarian follicles. During the proliferative phase of the menstrual cycle, rising oestrogen levels stimulate active cellular mitosis within the uterine endometrium, promoting repair, vascularization, and significant thickening of the uterine lining to prepare for potential embryo implantation.

125. (B) The start of the last menstrual period
In clinical obstetrics, gestational age and the estimated delivery date are calculated from the first day of the mother's last normal menstrual period. Because the precise timing of ovulation and fertilization is difficult to pinpoint, this standard calendar benchmark provides a consistent reference for tracking foetal development.

126. (B) Ultrasound scanning
Ultrasound scanning is a non-invasive diagnostic technique that uses high-frequency sound waves to visualize foetal development inside the womb. Although intended to assess foetal health and physiological growth, it is sometimes unethically misused for prenatal sex determination, leading to sex-selective female foeticide and prompting strict legal prohibition.

127. (B) It causes an imbalanced sex ratio with fewer females
Female foeticide involves the selective termination of female foetuses following illegal sex-determination tests. This harmful social practice severely distorts the overall population sex ratio, resulting in a shortage of females relative to males, which triggers widespread social issues, increases gender-based violence, and destabilizes long-term demographic balance across communities.

128. (C) Uterus
Intrauterine devices, such as the Copper-T, are long-acting reversible contraceptives inserted directly into the female uterine cavity by trained healthcare professionals. Positioned inside the uterus, the device continuously releases copper ions that disrupt sperm motility, alter endometrial characteristics, and prevent embryonic implantation without altering systemic hormonal cycles.

129. (D) They do not protect against STDs
Oral contraceptive pills offer highly effective birth control by modulating female reproductive hormone levels to inhibit ovulation. However, a major health disadvantage is that they offer no physical protection against sexually transmitted infections, requiring individuals to use barrier methods like condoms to prevent disease transmission during intercourse.

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130. (A) P-3, Q-4, R-1, S-2
Key reproductive events correspond to distinct physiological processes. Menstruation is the cyclic shedding of the inner uterine lining when fertilization does not occur. Gestation represents the duration of embryonic development during pregnancy. Parturition is the biological act of delivering a baby, and menopause marks the permanent end of menstrual cycles.

131. (B) It produces offspring genetically identical to the parent
Asexual reproduction involves a single parent organism producing offspring without gamete formation or fertilization. Because cell division relies entirely on mitosis, genetic material is copied exactly, yielding offspring that are genetically identical clones of the parent, unlike sexual reproduction which consistently introduces genetic variation through dual parental combinations.

132. (B) Seminiferous tubules
The human testes contain hundreds of microscopic, highly coiled structures known as seminiferous tubules, which serve as the primary site for spermatogenesis. Lined with germ cells and supporting Sertoli cells, these tubules facilitate meiotic division and structural transformation of developing germ cells into functional, mature sperm cells.

containing twenty-three single chromosomes, ensuring chromosome stability upon fertilization.

174. (D) Fertilisation
Fertilization is the fundamental biological process involving the physical union and nuclear fusion of a haploid male gamete with a haploid female gamete. Occurring typically in the fallopian tube, fertilization combines paternal and maternal genetic material, restoring the full diploid chromosome complement and forming a genetically unique single-celled zygote.

175. (C) III only
Implantation is the crucial process where a developing blastocyst attaches to and embeds into the vascular inner lining of the uterus roughly a week after fertilization. Statement three is incorrect because implantation involves a fertilized, dividing embryo, not an unfertilized egg, which degenerates without attaching to uterine walls.

176. (C) Nucleus
The nucleus is the spherical membrane-bound organelle inside a human egg cell that houses its nuclear genetic material. Containing twenty-three single maternal chromosomes, the haploid nucleus of the ovum unites with the paternal nucleus of the sperm during fertilization, contributing half of the genomic DNA required for zygote development.

177. (C) Sperm combined with accessory gland secretions
Semen is the complex fluid ejaculated from the male urethra during sexual climax. It comprises mature sperm cells produced in the testes combined with nutrient-rich, alkaline seminal plasma secreted by male accessory glands, including the seminal vesicles, prostate gland, and bulbourethral glands, which nourish and protect moving sperm cells.

178. (D) It undergoes a rapid growth spurt
Early puberty is characterized by a rapid surge in physical growth known as the pubertal growth spurt. Triggered by increased secretion of growth hormone alongside sex steroids like testosterone and oestrogen, adolescents experience accelerated longitudinal skeletal growth, rapid increases in height and weight, and marked changes in body composition.

179. (C) Breast enlargement
The onset of female puberty is marked by initial breast development, driven by rising ovarian oestrogen levels. Oestrogen stimulates the active growth of adipose tissue and ductal networks in the mammary glands. This physical change represents a primary female secondary sexual characteristic, occurring alongside axillary hair growth and eventual menarche onset.

180. (C) Menstruation → Thickening of uterine lining → Ovulation → Breakdown of lining
If fertilization does not occur, the female cycle repeats in a distinct order. Menstrual bleeding clears the degraded endometrium. Oestrogen then promotes the thickening and repair of the uterine lining. Ovulation releases an egg near mid-cycle. Finally, falling progesterone levels trigger the breakdown and shedding of the lining once again.

181. (B) Intrauterine Device
The abbreviation IUD stands for Intrauterine Device, representing a popular category of long-acting, reversible birth control methods. Placed inside the female uterine cavity by healthcare professionals, IUDs include hormonal and copper devices that prevent pregnancy by inhibiting sperm motility, altering endometrial tissue, and blocking embryonic implantation effectively.

182. (D) It prevents sperm from entering the cervix
A condom is a non-surgical, flexible barrier contraceptive sheath placed over the erect penis or inside the vagina prior to intercourse. It functions by trapping ejaculated semen within its tip, physically preventing sperm from entering the cervical canal and reaching the upper reproductive tract, while leaving female hormonal cycles unaffected.

183. (D) Adequate rest and regular medical check-ups
Maintaining maternal health during late pregnancy requires comprehensive care, including balanced nutrition, adequate physical rest, and regular antenatal medical check-ups. Monitoring maternal blood pressure, foetal growth, placental positioning, and maternal blood parameters ensures early identification and clinical management of potential complications, safeguarding both mother and baby before delivery.

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184. (B) It improves species survival in changing environments
Genetic variation within a population provides diverse traits across individuals, ensuring evolutionary flexibility. When environmental conditions change or novel diseases emerge, varied genetic combinations increase the biological likelihood that certain individuals possess adaptations necessary for survival, preventing total species extinction and driving long-term natural selection and adaptation.

185. (C) I, II and III only
Asexual reproduction involves one parent producing identical clones via mitosis, whereas sexual reproduction requires two parents, gamete formation through meiosis, and fertilization, generating substantial offspring variation. Statement four is incorrect because sexual reproduction, not asexual reproduction, represents the natural primary mode of reproduction in human beings globally.

186. (B) Gestation period
The gestation period defines the timeframe during which an embryo develops within the maternal uterus, spanning from initial fertilization to final delivery. In humans, normal gestation lasts approximately forty weeks or nine calendar months, during which a single-celled zygote differentiates into a complex, fully formed neonate ready for birth.

187. (D) Placenta
Beyond facilitating nutrient and gas exchange, the placenta serves as a vital temporary endocrine gland during pregnancy. It synthesizes and secretes essential hormones, including Human Chorionic Gonadotropin, progesterone, oestrogen, and Human Placental Lactogen, which actively maintain the uterine endometrium, prevent contractions, and adapt maternal metabolism to support gestation.

188. (A) To prevent bacterial and fungal infections
External genital structures feature sweat glands, oil glands, and skin folds where smegma and secretions can collect. Practicing regular personal hygiene and thorough washing prevents the proliferation of harmful bacteria and fungi, effectively protecting both males and females from unpleasant odors, skin irritation, urethritis, and secondary reproductive tract infections.

189. (C) Bacteria
Gonorrhoea is a contagious sexually transmitted infection caused by the Gram-negative bacterium Neisseria gonorrhoeae. This bacterial pathogen targets mucosal membranes of the urogenital tract, including the urethra, cervix, and rectum, causing symptoms such as painful urination, abnormal purulent discharge, and severe inflammation if left untreated with antibiotic therapy.

190. (A) II, III, I
Normal labor and childbirth proceed through three distinct, orderly stages. First, uterine contractions bring about effacement and complete dilation of the cervix. Second, active expulsion pushes the baby through the birth canal for delivery. Third, continued contractions cause the detachment and expulsion of the placenta and fetal membranes.

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191. (B) Using condoms during intercourse
Human Immunodeficiency Virus transmits through bodily fluids during unprotected sexual contact, needle sharing, or infected blood transfers. Utilizing latex condoms during sexual intercourse forms an impermeable physical barrier that blocks fluid exchange, providing a highly effective defense against contracting or transmitting HIV and other viral sexually transmitted pathogens.

192. (D) Testis - Testosterone
The human testes are primary male gonads containing interstitial Leydig cells that produce testosterone, the principal male sex hormone. Testosterone stimulates male embryonic differentiation, pubertal maturation, secondary sexual characteristics, and ongoing spermatogenesis. In contrast, ovaries produce oestrogen and progesterone, making the pairing of testis and testosterone biologically accurate.

193. (B) Carbon dioxide
As embryonic cells actively metabolize nutrients like glucose for energy, they generate cellular waste products, primarily carbon dioxide and nitrogenous compounds. These metabolic wastes enter foetal capillaries and diffuse across thin placental membranes into the maternal bloodstream, allowing the mother's respiratory and excretory systems to eliminate them efficiently.

194. (D) It degenerates and sheds during menstruation
A mature egg released during ovulation remains viable in the fallopian tube for approximately twelve to twenty-four hours. If fertilizing sperm are absent, the unfertilized ovum loses metabolic viability and degenerates. It then travels into the uterine cavity, shedding along with the inner endometrial lining during the next menstruation.

195. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Sexual reproduction produces greater genetic variation because it requires the union of haploid gametes from two distinct individual parents. Meiotic crossing over and random fertilization blend unique maternal and paternal genetic sequences into novel combinations in the zygote. Therefore, both statements are true, and the reason correctly explains the assertion.

196. (B) Male infertility
Male infertility refers to a male's inability to cause pregnancy in a fertile female partner. Oligospermia, characterized by an abnormally low sperm count per milliliter of ejaculate, severely decreases the statistical probability of sperm successfully ascending the female tract to fertilize an egg, representing a common cause of male infertility.

197. (C) Tubectomy
Tubectomy is a permanent surgical method of contraception in females involving the cutting, tying, or sealing of both fallopian tubes. By creating a physical obstruction in the oviducts, the procedure permanently prevents released eggs from moving down the tube and meeting sperm, thereby stopping gamete interaction and preventing fertilization.

198. (D) Its main body parts are identifiable
Following fertilization, the developing organism is termed an embryo during early cellular multiplication and organ establishment. Around the eighth week of human gestation, primary organ systems have formed and distinct body parts, including limbs, facial features, and digits, become recognizable, marking the developmental transition where it is classified as a foetus.

199. (B) To restore the normal diploid chromosome count in the zygote
Somatic cells are diploid, carrying two full sets of chromosomes. Meiotic division reduces chromosome numbers by half in germ cells, producing haploid gametes with one set each. This reduction ensures that when male and female gametes fuse during fertilization, the resulting zygote inherits the correct diploid chromosome complement for the species.

200. (B) To improve life quality, maternal health, and resource sustainability
Family planning programs and population control strategies focus on empowering individuals with reproductive knowledge and accessible birth control. Regulating family size and child spacing improves maternal and child health outcomes, reduces socioeconomic poverty, relieves extreme environmental strain on natural resources, and ensures sustainable economic development for all future generations.

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Emergence of plumule
(D) Absorption of water, Emergence of plumule, Emergence of radicle

51. The part of the embryonic axis that develops into the root system is called what?
(A) Plumule
(B) Hypocotyl
(C) Radicle
(D) Cotyledon

52. The part of the embryonic axis that develops into the shoot system is called what?
(A) Plumule
(B) Radicle
(C) Seed coat
(D) Endosperm

53. Which of the following plants typically produces dicotyledonous seeds?
(A) Wheat
(B) Rice
(C) Maize
(D) Gram

54. Which of the following plants typically produces monocotyledonous seeds?
(A) Pea
(B) Bean
(C) Mustard
(D) Maize

55. Consider the following three statements regarding endosperm:
I. It is formed as a result of triple fusion.
II. It provides nourishment to the developing embryo.
III. It is always entirely consumed before the seed matures in all plants.
Which combination of statements is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

56. Vegetative propagation in Bryophyllum naturally takes place through which part?
(A) Roots
(B) Leaves
(C) Stem tubers
(D) Flowers

57. Which of the following is a commercial method of vegetative propagation where a piece of stem is placed in the soil to grow a new plant?
(A) Grafting
(B) Layering
(C) Tissue culture
(D) Cutting

58. The natural phenomenon where a ripe ovary develops into a fruit without fertilisation is called what?
(A) Parthenocarpy
(B) Parthenogenesis
(C) Apomixis
(D) Vegetative propagation

59. Which plant hormone promotes cell division and is often found in high concentrations in developing fruits and seeds?
(A) Auxin
(B) Abscisic acid
(C) Cytokinin
(D) Ethylene

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60. The hormone generally associated with the inhibition of growth and promotion of seed dormancy is what?
(A) Gibberellin
(B) Auxin
(C) Cytokinin
(D) Abscisic acid

61. Which structural adaptation is most likely found in a flower pollinated by nocturnal insects like moths?
(A) Bright red petals
(B) Production of large amounts of dry pollen
(C) Absence of nectar
(D) White petals and strong fragrance

62. Which step must follow pollination for the formation of a seed to occur?
(A) Seed dispersal
(B) Fertilisation
(C) Germination
(D) Vegetative propagation

63. What is the primary purpose of emasculation in artificial hybridisation?
(A) To prevent cross-pollination
(B) To prevent self-pollination
(C) To increase nectar production
(D) To protect the flower from insects

64. Why is economic agriculture highly dependent on insect pollinators?
(A) They ensure fertilisation, boosting fruit and seed yields.

13. Which part of the seed stores food for the early development of the embryo in many plants?
(A) Cotyledon
(B) Seed coat
(C) Radicle
(D) Plumule

14. Fruits that develop from a single ovary of a single flower are classified as which type of fruit?
(A) Aggregate fruits
(B) Composite fruits
(C) Simple fruits
(D) False fruits

15. Consider the following three statements regarding seed dispersal:
I. It prevents overcrowding of plants in one area.
II. It increases competition among seedlings of the same plant.
III. It helps plants colonise new habitats.
Which combination of statements is correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II and III

16. The process by which a dormant seed begins to grow under favourable conditions is called what?
(A) Dispersal
(B) Pollination
(C) Germination
(D) Fertilisation

17. The tissue that nourishes the developing embryo in the seeds of angiosperms is known as what?
(A) Seed coat
(B) Endosperm
(C) Radicle
(D) Epidermis

18. Plants with seeds that have two cotyledons are known as what?
(A) Monocots
(B) Gymnosperms
(C) Bryophytes
(D) Dicots

19. The method of producing new plants from roots, stems, or leaves is called what?
(A) Vegetative propagation
(B) Sexual reproduction
(C) Spore formation
(D) Fragmentation

20. Which plant hormone is primarily responsible for the ripening of fruits?
(A) Auxin
(B) Gibberellin
(C) Ethylene
(D) Cytokinin

21. Which statement accurately describes the fundamental difference between pollination and fertilisation?
(A) Pollination is pollen transfer, while fertilisation is the fusion of gametes.
(B) Pollination is gamete fusion, while fertilisation is the transfer of gametes.
(C) Pollination takes place in the ovary, while fertilisation occurs on the stigma.
(D) Pollination depends on water currents, while fertilisation depends on wind.

22. Some flowers possess brightly coloured petals and produce nectar. These features are primarily adaptations for which type of pollination?
(A) Wind pollination
(B) Water pollination
(C) Self-pollination
(D) Insect pollination

23. The technique of crossing two different varieties of plants to obtain a new variety with desired traits is known as what?
(A) Emasculation
(B) Hybridisation
(C) Tissue culture
(D) Parthenocarpy

24. How does the pollination process primarily contribute to economic agricultural production?
(A) By reducing the total requirement for chemical fertilisers
(B) By stimulating higher rates of vegetative photosynthesis
(C) By enabling essential fruit and seed set in crop plants
(D) By enhancing natural resistance against infectious diseases

25. Consider the following four statements regarding the role of bees in the ecosystem:
I. They act as major pollinators for many food crops.
II. They decrease the genetic diversity of plants.
III. They help in the production of honey and beeswax.
IV. They transfer pollen from the stigma to the

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CHAPTER 11

Sexual Reproduction in Flowers

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1. Which part of the plant is primarily responsible for sexual reproduction in angiosperms?
(A) Stem
(B) Flower
(C) Root
(D) Leaf

2. What is the outermost whorl of a typical flower called?
(A) Corolla
(B) Androecium
(C) Gynoecium
(D) Calyx

3. Which of the following parts constitutes the male reproductive organ of a flower?
(A) Stamen
(B) Pistil
(C) Sepal
(D) Petal

4. The female reproductive part of a flower is known as the carpel or pistil. Which of the following is not a part of the pistil?
(A) Stigma
(B) Style
(C) Anther
(D) Ovary

5. In a flower, pollen grains are produced inside which specific structure?
(A) Anther
(B) Filament
(C) Ovary
(D) Stigma

6. The transfer of pollen grains from the anther to the stigma of a flower is defined as which of the following processes?
(A) Fertilisation
(B) Germination
(C) Dispersal
(D) Pollination

7. When pollen from the anther of one flower is transferred to the stigma of the same flower, the process is specifically called what?
(A) Cross-pollination
(B) Self-pollination
(C) Double fertilisation
(D) Vegetative propagation

8. Which of the following is a common abiotic agent of pollination?
(A) Insects
(B) Birds
(C) Wind
(D) Bats

9. After a pollen grain lands on a suitable stigma, it develops a structure to carry male germ cells to the ovary. What is this structure called?
(A) Style
(B) Filament
(C) Micropyle
(D) Pollen tube

10. Select the correct sequence of events during sexual reproduction in flowering plants.
(A) Fertilisation, Pollination, Embryo formation, Seed formation
(B) Pollination, Fertilisation, Embryo formation, Seed formation
(C) Seed formation, Embryo formation, Fertilisation, Pollination
(D) Pollination, Embryo formation, Fertilisation, Seed formation

11. The unique process in flowering plants where one male gamete fuses with the egg cell and another male gamete fuses with the polar nuclei is known as what?
(A) Cross-pollination
(B) Double fertilisation
(C) Parthenogenesis
(D) Vegetative propagation

12. After fertilisation, the ovule of a flower develops into which structure?
(A) Fruit
(B) Seed
(C) Endosperm
(D) Cotyledon

(C) Hermaphrodite
(D) Complete

38. The transfer of pollen from the anther of one flower to the stigma of another flower on a different plant is termed what?
(A) Autogamy
(B) Geitonogamy
(C) Bud pollination
(D) Cross-pollination

39. Which characteristic is typical of wind-pollinated flowers?
(A) Light, non-sticky pollen grains
(B) Large and brightly coloured petals
(C) Production of nectar
(D) Strong fragrance

40. Water pollination is mostly observed in which of the following groups of plants?
(A) Arid desert succulents
(B) Native terrestrial orchids
(C) Aquatic plants like Hydrilla
(D) High-altitude coniferous trees

41. Which part of the carpel acts as a sticky surface to capture pollen grains?
(A) Style
(B) Ovary
(C) Stigma
(D) Ovule

42. In a pollen tube, how many male gametes travel towards the embryo sac?
(A) One
(B) Two
(C) Three
(D) Four

43. During double fertilisation, one male gamete fuses with the egg cell. What does the other male gamete fuse with?
(A) Synergids
(B) Secondary nucleus
(C) Antipodal cells
(D) Integuments

44. What is the product of the fusion of a male gamete with the egg cell?
(A) Primary endosperm nucleus
(B) Polar body
(C) Cotyledon
(D) Zygote

45. Match the plant parts in List I with their post-fertilisation fate in List II.
List I: Plant Part
P. Ovary
Q. Ovule
R. Zygote
S. Integuments
List II: Post-fertilisation Fate
1. Seed coat
2. Fruit
3. Seed
4. Embryo
Select the correct matching code:
(A) P-2, Q-3, R-4, S-1
(B) P-3, Q-2, R-4, S-1
(C) P-2, Q-3, R-1, S-4
(D) P-1, Q-2, R-3, S-4

46. Which of the following is an example of an aggregate fruit?
(A) Strawberry
(B) Mango
(C) Apple
(D) Coconut

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47. A fruit that develops not only from the ovary but also involves the thalamus is called a false fruit. Which of the following is a common example?
(A) Tomato
(B) Grape
(C) Orange
(D) Apple

48. Seed dispersal by wind is commonly facilitated by which of the following adaptations?
(A) Wing-like or hair-like seed structures
(B) Fleshy, sweet, and edible fruit walls
(C) Extremely hard and heavy seed coats
(D) Brightly coloured and attractive seeds

49. Seeds of Xanthium and Urena are primarily dispersed by which agent?
(A) Wind
(B) Water
(C) Animals
(D) Self-explosion

50. Select the correct sequence of stages during seed germination.
(A) Emergence of plumule, Absorption of water, Emergence of radicle
(B) Absorption of water, Emergence of radicle, Emergence of plumule
(C) Emergence of radicle, Absorption of water,

anther.
Which combination of statements is correct?
(A) I and III
(B) II and IV
(C) I, III and IV
(D) I, II, III and IV

26. Which of the following is a common symptom of a reproductive disorder in flowering plants?
(A) Excessive root growth
(B) Premature flower drop
(C) Increased rate of transpiration
(D) Enhanced green colour in leaves

27. The development of a fruit without the process of fertilisation is called what?
(A) Apomixis
(B) Parthenogenesis
(C) Parthenocarpy
(D) Polyembryony

28. What is the primary ecological importance of sexual reproduction in flowering plants?
(A) It produces genetic variation in plant populations.
(B) It produces genetically identical clones of parent plants.
(C) It eliminates reliance on external pollinating agents.
(D) It systematically reduces the lifespan of parent plants.

29. The individual units that make up the corolla of a flower are known as what?
(A) Sepals
(B) Stamens
(C) Petals
(D) Carpels

30. Consider the following parts of a pistil:
I. Ovary
II. Stigma
III. Style
Which of the following represents the correct order of these parts from top to bottom?
(A) I, II, III
(B) II, III, I
(C) III, II, I
(D) II, I, III

31. The swollen base of the carpel containing ovules is known as what?
(A) Stigma
(B) Style
(C) Ovary
(D) Thalamus

32. Which part of the stamen provides support to the anther?
(A) Filament
(B) Connective
(C) Petal
(D) Receptacle

33. What is the primary function of the calyx in a flower?
(A) To attract insect vectors for successful cross-pollination
(B) To protect the flower bud during early development
(C) To produce and release microscopic pollen grains
(D) To receive pollen grains during the pollination process

34. Which of the following structures develops into a seed coat after fertilisation?
(A) Ovule integuments
(B) Wall of the ovary
(C) Primary endosperm
(D) Embryo synergids

35. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Self-pollination usually results in offspring that are genetically identical to the parent.
Reason (R): Self-pollination involves the transfer of pollen between flowers of two different plants of the same species.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

36. Which term describes flowers that contain both stamens and pistils?
(A) Unisexual flowers
(B) Incomplete flowers
(C) Bisexual flowers
(D) Staminate flowers

37. Papaya and watermelon flowers usually contain either stamens or pistils but not both. What are such flowers called?
(A) Unisexual
(B) Bisexual

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(B) They actively protect growing crop plants from grazing animals.
(C) They continuously supply essential nitrogen to the soil.
(D) They systematically assist in weed control around crops.

65. Consider the following four statements regarding self-pollination:
I. It does not require external pollinating agents.
II. It increases genetic variation in the offspring.
III. It can occur even if the flower does not open.
IV. It is the transfer of pollen between two different plant species.
Which combination of statements is correct?
(A) I and II
(B) I and III
(C) II and IV
(D) III and IV

66. A flower lacks sepals, petals, and stamens, possessing only a pistil. How can this flower be described?
(A) Fully bisexual and complete
(B) Fully unisexual and complete
(C) Fully bisexual and incomplete
(D) Fully unisexual and incomplete

67. Which of the following is an example of a naturally seedless fruit produced via parthenocarpy?
(A) Banana
(B) Mango
(C) Papaya
(D) Pomegranate

68. The ecological importance of sexual reproduction includes producing seeds that can survive harsh conditions. What makes the seed capable of surviving these conditions?
(A) Possession of a thick and fleshy protective fruit wall
(B) Development and presence of an unusually large flower
(C) Maintenance of continuous active growth in the seed
(D) A hard seed coat combined with low moisture content

69. Which part of the flower attracts insects by offering nectar as a reward?
(A) Sepal
(B) Nectary gland
(C) Ovule
(D) Stigma

70. Consider the following events of sexual reproduction in a plant:
I. Formation of zygote
II. Germination of pollen grain
III. Formation of pollen tube
IV. Double fertilisation
Which of the following represents the correct sequence of these events?
(A) II, III, I, IV
(B) II, III, IV, I
(C) III, II, I, IV
(D) I, II, III, IV

71. The stalk of a flower is known as what?
(A) Petiole
(B) Peduncle
(C) Thalamus
(D) Pedicel

72. The expanded upper end of the flower stalk to which floral parts are attached is termed the what?
(A) Thalamus
(B) Filament
(C) Corolla
(D) Bract

73. All the stamens in a flower collectively form which whorl?
(A) Gynoecium
(B) Calyx
(C) Androecium
(D) Corolla

74. Which of the following correctly pairs a floral whorl with its individual units?
(A) Calyx - Petals
(B) Corolla - Sepals
(C) Gynoecium - Carpels
(D) Androecium - Carpels

75. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The pollen grain represents the male gametophyte in flowering plants.
Reason (R): Pollen grains produce male gametes required for fertilisation.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.

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(D) Assertion (A) is false but Reason (R) is true.

76. Inside the ovule, the female gametophyte is called what?
(A) Embryo sac
(B) Endosperm
(C) Nucellus
(D) Micropyle

77. The protective outer layer of a pollen grain is called what?
(A) Intine
(B) Epidermis
(C) Endothecium
(D) Exine

78. Which of the following environmental factors is essential for the germination of seeds?
(A) Extreme heat
(B) Water (moisture)
(C) Absence of oxygen
(D) Direct strong sunlight only

79. The fusion product of the male gamete with the secondary nucleus is called what?
(A) Zygote
(B) Synergid
(C) Antipodal cell
(D) Primary endosperm nucleus

80. The process by which mature pollen is released from the anther is called what?
(A) Dehiscence
(B) Germination
(C) Plasmolysis
(D) Emasculation

81. In an embryo sac, the egg apparatus is situated at which end?
(A) Chalazal end
(B) Central cell
(C) Integument
(D) Micropylar end

82. Which structures in the embryo sac guide the pollen tube towards the egg cell?
(A) Antipodals
(B) Synergids
(C) Polar nuclei
(D) Central cells

83. Cross-pollination is often more advantageous than self-pollination because it leads to what?
(A) Increased genetic variation among offspring
(B) Significantly accelerated flowering periods
(C) Lower overall energy expenditure by plants
(D) Reduced production of viable plant seeds

84. Which of the following plants usually exhibits cross-pollination due to its unisexual flowers?
(A) Pea
(B) Hibiscus
(C) Mustard
(D) Papaya

85. Match the pollination agent in List I with its corresponding botanical term in List II.
List I: Pollination Agent
P. Wind
Q. Water
R. Insects
S. Birds
List II: Botanical Term
1. Entomophily
2. Anemophily
3. Ornithophily
4. Hydrophily
Select the correct matching code:
(A) P-2, Q-4, R-1, S-3
(B) P-4, Q-2, R-1, S-3
(C) P-2, Q-4, R-3, S-1
(D) P-1, Q-2, R-4, S-3

86. Which feature is an adaptation for preventing self-pollination in a bisexual flower?
(A) Stamens and carpels maturing at precisely the same time
(B) Stamens and carpels maturing at different times
(C) Floral structures remaining permanently closed
(D) Stamens growing significantly taller than the stigma

87. The small pore in the seed coat through which water enters during germination is called what?
(A) Hilum
(B) Chalaza
(C) Funicle
(D) Micropyle

88. A fruit like a mango, which has a hard, stony endocarp, is classified botanically as a what?
(A) Berry
(B) Drupe
(C) Pome
(D) Legume

89. Which of the following is not a requirement for standard seed germination?

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(A) Oxygen
(B) Favourable temperature
(C) Carbon dioxide
(D) Moisture

90. Select the correct sequence of structures a pollen tube passes through to reach the ovule.
(A) Stigma, Ovary, Style, Micropyle
(B) Stigma, Style, Ovary, Micropyle
(C) Style, Stigma, Micropyle, Ovary
(D) Micropyle, Style, Stigma, Ovary

91. The seeds of the coconut plant are well-adapted for dispersal by which agent?
(A) Wind
(B) Water
(C) Insects
(D) Explosive mechanism

92. The cotyledons of a dicot seed primarily serve what function?
(A) Storage of food reserves
(B) Protection from herbivores
(C) Photosynthesis during germination
(D) Water absorption from deep soil

93. In monocot seeds like maize, the large shield-shaped cotyledon is specifically called what?
(A) Coleoptile
(B) Coleorhiza
(C) Scutellum
(D) Aleurone layer

94. The protective sheath covering the plumule in monocot seeds is called what?
(A) Coleorhiza
(B) Seed coat
(C) Scutellum
(D) Coleoptile

95. Consider the following three statements regarding vegetative propagation:
I. It produces plants that are genetically identical to the parent.
II. It takes a longer time to produce flowers compared to plants grown from seeds.
III. It is a form of asexual reproduction.
Which combination of statements is correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II and III

96. Which artificial method of vegetative propagation involves joining a scion to a stock?
(A) Layering
(B) Cutting
(C) Grafting
(D) Budding

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97. The hormone primarily applied to stem cuttings to promote root formation is what?
(A) Auxin
(B) Gibberellin
(C) Ethylene
(D) Abscisic acid

98. Gibberellins are known to induce which phenomenon in certain plants, aiding in fruit development?
(A) Seed dormancy
(B) Leaf fall
(C) Stomatal closure
(D) Parthenocarpy

99. The complete life cycle of an angiosperm involves an alternation of generations between the sporophyte and which other phase?
(A) Gametophyte
(B) Zygote
(C) Endosperm
(D) Embryo

100. In the angiosperm life cycle, the mature plant body that we see (e.g., a mango tree) represents which generation?
(A) Haploid gametophyte
(B) Diploid sporophyte
(C) Triploid endosperm
(D) Haploid sporophyte

101. Which statement identifies an incorrect pairing of a reproductive process and its outcome?
(A) Pollination - Pollen reaches stigma
(B) Syngamy - Formation of zygote
(C) Triple fusion - Formation of primary endosperm nucleus
(D) Germination - Formation of gametes

102. Which of the following traits is NOT typically associated with insect-pollinated flowers?
(A) Extremely sticky or spiky pollen grains
(B) Small or inconspicuous petals
(C) Continuous production of sweet nectar
(D) Emission of a strong floral fragrance

103. Hybridisation is best described as the process of what?
(A) Crossing different individuals to combine desired traits

(B) They change colour to attract more insects.
(C) They wither and fall off.
(D) They fuse to form the seed coat.

179. In some plants like tomato and brinjal, the sepals remain attached to the fruit even after it ripens. What are these sepals called?
(A) Deciduous sepals
(B) Persistent sepals
(C) Petaloid sepals
(D) Fleshy sepals

180. Match the floral part in List I with its corresponding collective term in List II.
List I: Floral Part
P. Sepal
Q. Petal
R. Stamen
S. Carpel
List II: Collective Term
1. Androecium
2. Corolla
3. Gynoecium
4. Calyx
Select the correct matching code:
(A) P-4, Q-2, R-1, S-3
(B) P-2, Q-4, R-1, S-3
(C) P-4, Q-2, R-3, S-1
(D) P-1, Q-2, R-4, S-3

181. In an embryo sac, how many cells usually form the egg apparatus at the micropylar end?
(A) One
(B) Two
(C) Three
(D) Four

182. The three cells situated at the chalazal end of the embryo sac are known as what?
(A) Synergids
(B) Polar nuclei
(C) Antipodals
(D) Egg cells

183. Identify the incorrect statement about the embryo sac in a typical angiosperm.
(A) It represents the female gametophyte.
(B) It is enclosed within the ovule.
(C) At maturity, it typically contains 8 nuclei and 7 cells.
(D) It is a diploid structure prior to fertilisation.

184. The function of the synergids in the embryo sac is primarily what?
(A) To store food for the developing embryo
(B) To guide the entry of the pollen tube
(C) To fuse with the male gamete to form the endosperm
(D) To protect the antipodals

185. Consider the following four statements regarding sexual reproduction in flowers:
I. It ensures mixing of genetic material.
II. It leads to the formation of seeds.
III. It always requires water for gamete transfer.
IV. It relies on meiosis for gamete formation.
Which combination of statements is correct?
(A) I, II and IV
(B) I, III and IV
(C) II, III and IV
(D) I, II and III

186. During self-pollination, what is the main mechanism that plants use to prevent inbreeding depression if self-incompatibility is present?
(A) Exclusively producing male flowers on all branches
(B) Producing chemically toxic pollen grains on stamens
(C) Inhibiting self-pollen tube growth
(D) Prematurely shedding all open floral structures

187. Some plants reproduce asexually using modified underground stems. Which of the following is an example of an underground stem modification used for propagation?
(A) Radish
(B) Carrot
(C) Potato
(D) Sweet potato

188. Which of the following represents an incorrect pair of a plant and its typical pollinating agent?
(A) Maize - Wind
(B) Vallisneria - Water
(C) Sunflower - Insect
(D) Lotus - Bat

189. In many dicot seeds, the structure that connects the plumule and radicle is called the embryonal axis. The portion of the embryonal axis above the level of cotyledons is called what?
(A) Hypocotyl
(B) Epicotyl
(C) Coleoptile
(D) Scutellum

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(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

116. Which part of the embryo acts as the first pair of leaves in a newly germinated dicot plant?
(A) Radicle
(B) Endosperm
(C) Cotyledons
(D) Seed coat

117. Epigeal germination is characterised by what?
(A) The cotyledons remaining below the soil surface
(B) The cotyledons being pushed above the soil surface
(C) The seed germinating inside the fruit on the parent plant
(D) The radicle failing to emerge

118. Hypogeal germination is characterised by what?
(A) The cotyledons being actively pushed far above the soil level
(B) The cotyledons remaining beneath the soil surface
(C) The rapid formation of multiple secondary radicles
(D) The complete absence of a functional plumule

119. In double fertilisation, the ploidy level of the primary endosperm nucleus (PEN) is what?
(A) Haploid (n)
(B) Diploid (2n)
(C) Triploid (3n)
(D) Tetraploid (4n)

120. Which of the following describes the ploidy of a normal plant zygote?
(A) Haploid (n)
(B) Diploid (2n)
(C) Triploid (3n)
(D) Polyploid

121. The central cell of the embryo sac, before fertilisation, contains what?
(A) One haploid nucleus
(B) Two polar nuclei
(C) Three antipodal nuclei
(D) Four synergid nuclei

122. Identify the incorrect statement regarding monocot seeds.
(A) They consistently possess only one single cotyledon
(B) They typically retain a large and prominent endosperm
(C) Their embryo contains two distinct cotyledons
(D) Common cereal grains like maize and wheat are examples

123. Identify the correct pair among the following.
(A) Radicle - Future shoot
(B) Endosperm - Food storage tissue
(C) Plumule - Future root
(D) Micropyle - Protective outer covering

124. The scar on the seed coat where the seed was attached to the fruit is known as what?
(A) Micropyle
(B) Tegmen
(C) Testa
(D) Hilum

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125. Match the plant in List I with its natural method of vegetative propagation in List II.

List I: Plant
P. Potato
Q. Bryophyllum
R. Sweet potato
S. Ginger

List II: Natural Method of Vegetative Propagation
1. Leaf margins
2. Stem tuber
3. Rhizome
4. Root tuber

Select the correct matching code:
(A) P-2, Q-1, R-4, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-4, Q-3, R-2, S-1
(D) P-2, Q-4, R-1, S-3

126. A disadvantage of vegetative propagation is what?
(A) New plants mature significantly slower than seed-grown plants
(B) Loss of genetic variation increases disease vulnerability
(C) Offspring fail to retain the desirable traits of the parent plant
(D) It requires complex and highly specific pollinator interactions

127. Which agricultural practice involves removing the anthers from a bisexual flower before they mature?
(A) Bagging
(B) Emasculation

(C) Layering
(D) Grafting

128. Why is bagging performed after emasculation during artificial hybridisation?
(A) To protect delicate floral organs from harsh weather
(B) To prevent unwanted pollen from reaching the stigma
(C) To significantly increase temperature around the flower
(D) To effectively trap nectar-feeding pollinating insects

129. The application of which hormone can induce parthenocarpy in fruits like tomatoes?
(A) Auxin
(B) Abscisic acid
(C) Ethylene
(D) Cytokinin

130. The primary advantage of seedless fruits in agriculture is what?
(A) They produce substantially higher yields of structural timber
(B) They have significantly longer lifespans than seeded plants
(C) They completely eliminate the agricultural requirement for regular watering
(D) They are preferred for fresh consumption and commercial processing

131. Which of the following is the most appropriate description of a complete flower?
(A) A flower that exclusively possesses both stamens and functional pistils
(B) A flower containing calyx, corolla, androecium, and gynoecium
(C) A flower that actively produces abundant amounts of nectar and pollen
(D) A flower that displays brightly coloured petals and a strong fragrance

132. What is the condition called when the calyx and corolla of a flower are not distinct from each other?
(A) Perianth
(B) Inflorescence
(C) Thalamus
(D) Bract

133. The individual units of a perianth are known as what?
(A) Petals
(B) Tepals
(C) Sepals
(D) Carpels

134. Which of the following flowers typically exhibits a perianth?
(A) Rose
(B) Sunflower
(C) Lily
(D) Pea

135. Consider the following three statements regarding the stamen:
I. It consists of an anther and a filament.
II. The anther is typically bilobed.
III. It receives pollen during pollination.
Which combination of statements is correct?
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II and III

136. The structural diversity in flower shapes, such as tubular or bell-shaped, is primarily an evolutionary adaptation for what purpose?
(A) To effectively reduce transpiration and prevent water loss
(B) To accommodate specific types of biological pollinators
(C) To maximize light absorption and photosynthetic surface area
(D) To serve as specialized tissues to store excess food

137. Which of the following is an example of a flower adapted for bird pollination (ornithophily)?
(A) Butea (Palash)
(B) Grasses
(C) Wheat
(D) Hydrilla

138. Flowers pollinated by wind are generally characterised by which feature?
(A) Production of copious nectar
(B) Brightly coloured petals
(C) Heavy, sticky pollen
(D) Large, feathery stigmas

139. How do bees detect nectar in flowers?
(A) Through subtle atmospheric auditory cues and ultrasonic sound vibrations
(B) Through visual nectar guides and floral scents
(C) By directly sensing thermal heat signatures emitted from the floral core
(D) By physically feeling the tactile microscopic

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texture of the plant stem

140. Which disease commonly affects the floral parts of a plant, reducing reproduction?
(A) Root rot
(B) Leaf rust
(C) Blossom end rot
(D) Stem blight

141. The failure of pollen grains to germinate on the stigma of the same flower due to genetic mechanisms is called what?
(A) Self-incompatibility
(B) Emasculation
(C) Parthenocarpy
(D) Apomixis

142. The process of sexual reproduction in plants contributes to ecological stability by what means?
(A) Systematically eliminating older individual plants from the habitat
(B) Maintaining genetic diversity within populations
(C) Completely halting the continuous biological process of evolution
(D) Gradually decreasing the total number of surviving plant species

143. Find the odd one out among the following parts.
(A) Stigma
(B) Style
(C) Anther
(D) Ovary

144. Find the odd one out concerning seed dispersal methods.
(A) Wind
(B) Water
(C) Animal
(D) Grafting

145. Consider the following four statements regarding seed germination:
I. It requires water to activate enzymes.
II. Oxygen is essential for respiration during germination.
III. It can occur efficiently at freezing temperatures.
IV. The radicle emerges before the plumule.
Which combination of statements is correct?
(A) I, II and IV
(B) II, III and IV
(C) I, III and IV
(D) I, II and III

146. Which part of the embryo is considered the precursor to the shoot system?
(A) Cotyledon
(B) Radicle
(C) Plumule
(D) Hypocotyl

147. A seed coat consists of two layers. The outer hard layer is called what?
(A) Testa
(B) Tegmen
(C) Endosperm
(D) Nucellus

148. The inner, thinner layer of the seed coat is called what?
(A) Testa
(B) Hilum
(C) Tegmen
(D) Chalaza

149. The small leaf-like structures found at the base of the flower stalk in some plants are called what?
(A) Petals
(B) Sepals
(C) Bracts
(D) Stipules

150. A flower that lacks a stalk and is attached directly to the stem is termed what?
(A) Pedicellate
(B) Sessile
(C) Complete
(D) Imperfect

151. Which of the following is the most appropriate definition of a dioecious plant?
(A) A plant that exclusively bears fully bisexual functional flowers
(B) A plant with male and female flowers on separate individuals
(C) A plant bearing both male and female flowers on the same individual plant
(D) A plant species that reproduces exclusively through vegetative methods

152. Papaya and date palm are examples of which type of plants?
(A) Monoecious
(B) Dioecious
(C) Hermaphrodite
(D) Parthenocarpic

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(B) Cloning a single plant multiple times to produce exact copies
(C) Growing plants in an artificial nutrient solution without soil
(D) Inducing genetic mutations using strong chemical agents

104. Which of the following is a major economic benefit provided by bees in agriculture?
(A) Complete eradication of agricultural pests
(B) Biological nitrogen fixation in plant roots
(C) Increased crop yield through pollination
(D) Significant reduction of topsoil erosion

105. Consider the following four statements regarding fruit formation:
I. True fruits develop solely from the ovary.
II. False fruits may involve the thalamus in their formation.
III. All fruits contain seeds.
IV. The ovary wall develops into the pericarp.
Which combination of statements is correct?
(A) I, II and III
(B) I, II and IV
(C) II, III and IV
(D) I, III and IV

106. A common disorder where a plant fails to set fruit despite abundant flowering may most likely be caused by what?
(A) Exposure to excess direct sunlight
(B) Continuous and severe over-watering
(C) Excessively high soil fertility levels
(D) A complete lack of effective pollinators

107. Which term refers to the shedding of flowers or premature fruits from a plant?
(A) Abscission
(B) Germination
(C) Parthenocarpy
(D) Dehiscence

108. The pericarp of a fleshy fruit is generally differentiated into how many layers?
(A) One
(B) Two
(C) Three
(D) Four

109. The innermost hard layer of the pericarp in a drupe (like mango) is called what?
(A) Epicarp
(B) Mesocarp
(C) Seed coat
(D) Endocarp

110. Consider the following fruit types based on standard botanical classification:
I. Aggregate fruit
II. Simple fruit
III. Composite fruit
Arrange these fruit types in sequence from a fruit with a single seed (e.g., Mango), to a fruit developed from multiple ovaries of a single flower (e.g., Strawberry), to a fruit developed from an entire inflorescence (e.g., Pineapple).
(A) II, I, III
(B) I, II, III
(C) III, I, II
(D) II, III, I

111. The edible part of an apple is structurally derived from which part of the flower?
(A) Ovary
(B) Thalamus
(C) Endosperm
(D) Cotyledon

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112. A composite fruit develops from what?
(A) A single ovary
(B) An entire inflorescence
(C) Multiple ovaries of a single flower
(D) Only the calyx of a flower

113. Jackfruit and pineapple are examples of which type of fruit?
(A) Composite fruits
(B) Simple fleshy fruits
(C) Simple dry fruits
(D) Aggregate fruits

114. The explosive mechanism for seed dispersal is observed in which of the following plants?
(A) Dandelion
(B) Coconut
(C) Balsam
(D) Lotus

115. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Seeds dispersed by wind are generally light and may have wings or hair-like structures.
Reason (R): These adaptations help the seeds to float in the air and be carried over long distances.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.

(A) P-3, Q-1, R-2, S-4
(B) P-1, Q-3, R-2, S-4
(C) P-3, Q-2, R-1, S-4
(D) P-2, Q-1, R-4, S-3

166. A student observing a seed notes that it splits easily into two identical halves. Which type of seed is this most likely to be?
(A) Wheat
(B) Rice
(C) Pea
(D) Maize

167. A seed lacking endosperm at maturity, such as a pea or bean, is called what?
(A) Albuminous seed
(B) Exalbuminous seed
(C) Non-endospermic seed
(D) Perispermic seed

168. Seeds of wheat and maize retain a part of the endosperm even at maturity. They are termed what?
(A) Exalbuminous seeds
(B) Albuminous seeds
(C) Parthenocarpic seeds
(D) Endospermic seeds

169. What is the state of inactivity in which a seed survives adverse environmental conditions before germinating?
(A) Senescence
(B) Dormancy
(C) Abscission
(D) Vernalisation

170. Which hormone is generally responsible for breaking seed dormancy and promoting germination?
(A) Abscisic acid
(B) Auxin
(C) Gibberellin
(D) Ethylene

171. The arrangement of flowers on the floral axis is known as what?
(A) Phyllotaxy
(B) Inflorescence
(C) Venation
(D) Placentation

172. The arrangement of ovules within the ovary is termed what?
(A) Aestivation
(B) Placentation
(C) Inflorescence
(D) Pollination

173. What is the process of pollen grain formation within the microsporangia of the anther formally called?
(A) Megasporogenesis
(B) Microsporogenesis
(C) Embryogenesis
(D) Parthenogenesis

174. The formation of the female gamete or egg cell inside the ovule is a part of which process?
(A) Microsporogenesis
(B) Megasporogenesis
(C) Pollination
(D) Germination

175. Consider the following three statements regarding hybridisation:
I. It involves the crossing of individuals with different desirable traits.
II. It is entirely a natural process and cannot be controlled by humans.
III. It results in offspring called hybrids.
Which combination of statements is correct?
(A) I and II only
(B) I and III only
(C) II and III only
(D) I, II and III

176. Which of the following best describes 'emasculation' during artificial hybridisation?
(A) The removal of petals to expose the reproductive organs
(B) The removal of anthers from a bisexual flower bud
(C) The dusting of foreign pollen onto the stigma
(D) The covering of the flower with a bag

177. A commercial grower wants to propagate a disease-resistant rose plant quickly while ensuring the new plants are genetically identical to the parent. Which method should be used?
(A) Vegetative propagation by stem cuttings
(B) Allowing unguided natural cross-pollination
(C) Sowing harvested seeds collected from the plant
(D) Inducing genetic mutations using chemical agents

178. What happens to the petals and sepals of most flowers immediately after fertilisation is successfully completed?
(A) They grow larger and become fleshy.

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ANSWERS

1. (B) Flower
In angiosperms, flowers function as the specialized reproductive structures that facilitate sexual reproduction. They contain essential reproductive organs, specifically stamens for male gamete production and carpels for female gamete production. Through mechanisms such as pollination and double fertilisation, flowers enable the production of seeds and fruits, ensuring species continuity across generations.

2. (D) Calyx
The calyx forms the outermost whorl of a typical angiosperm flower and is composed of individual leaf-like units called sepals. Its principal biological function is to enclose and protect the inner delicate floral organs during the bud stage of development. In addition, green sepals can perform photosynthesis to support young flower growth.

3. (A) Stamen
The stamen represents the male reproductive structure in flowering plants, collectively forming the androecium whorl. Each stamen typically consists of a slender stalk called the filament and a terminal two-lobed structure known as the anther. Microsporangia within the anther undergo meiotic division to produce microspores, which develop into pollen grains containing male gametes.

4. (C) Anther
The carpel or pistil constitutes the female reproductive organ of a flower and is structurally divided into three main regions: the stigma, style, and ovary. The anther is not part of the pistil because it belongs to the stamen, which is the male reproductive organ responsible for generating pollen grains during floral reproduction.

5. (A) Anther
Pollen grains develop inside the microsporangia located within the anther, which is the terminal fertile component of a stamen. Diploid microspore mother cells in the pollen sacs undergo meiotic cell division to generate haploid microspores. These microspores subsequently mature into pollen grains, which house the male gametes essential for plant sexual reproduction.

6. (D) Pollination
Pollination is the essential biological mechanism defined by the movement of mature pollen grains from the anther of a stamen to the receptive stigma surface of a carpel. This fundamental transfer allows male gametes to reach female reproductive structures, serving as a prerequisite step that must occur prior to fertilisation in angiosperms.

7. (B) Self-pollination
Self-pollination occurs when pollen grains are transferred from the anther to the stigma of the exact same flower or another flower on the same individual plant. Because genetic material originates from a single parent, this mechanism promotes genetic consistency across generations, although it limits overall genetic variability compared to cross-pollination between separate individual plants.

8. (C) Wind
Abiotic pollination relies on non-living physical forces in the environment rather than living organism vectors to transport pollen. Wind represents a major abiotic pollinating agent, carrying vast quantities of lightweight, dry pollen grains across distances. In contrast, organisms such as insects, birds, and bats act as biotic vectors that deliberately visit flowers for food rewards.

9. (D) Pollen tube
Upon landing on a compatible stigma, a germinating pollen grain absorbs moisture and nutrients to produce a elongated tubular extension known as a pollen tube. Driven by chemotropic factors, this tube grows down through the style tissue to transport two non-motile male gametes directly into the embryo sac within the ovary for double fertilisation.

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10. (B) Pollination, Fertilisation, Embryo formation, Seed formation
Sexual reproduction in angiosperms follows an orderly developmental sequence. Pollination

190. The portion of the embryonal axis below the level of cotyledons that terminates in the radicle is known as what?
(A) Epicotyl
(B) Hypocotyl
(C) Plumule
(D) Hilum

191. In a typical flower, the ovary is superior and all other floral parts arise from below it. Such a flower is termed what?
(A) Hypogynous
(B) Epigynous
(C) Perigynous
(D) Cleistogamous

192. Flowers in which the ovary is inferior, and the other floral parts arise from above the ovary, are termed what?
(A) Epigynous
(B) Hypogynous
(C) Perigynous
(D) Unisexual

193. The primary nutrient stored in the endosperm of a cereal grain like wheat or rice is predominantly what?
(A) Protein
(B) Fat
(C) Starch
(D) Vitamin C

194. In the structure of a grass seed, the outer protective layer composed of the fused seed coat and fruit wall is called the what?
(A) Endocarp
(B) Aleurone layer
(C) Hull (Pericarp)
(D) Scutellum

195. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The development of fruits and seeds provides an evolutionary advantage to angiosperms.
Reason (R): Fruits protect the seeds and assist in their wide dispersal, ensuring the spread of the species.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

196. The process by which the embryo inside a seed becomes active and grows into a seedling is defined as what?
(A) Pollination
(B) Germination
(C) Fertilisation
(D) Plasmolysis

197. Which part of the seedling relies primarily on the food stored in the cotyledons before true leaves emerge?
(A) The fully mature secondary root system
(B) The developing reproductive flower clusters
(C) The young shoot and primary root
(D) The surrounding protective fruit structures

198. The most crucial role of flowers in the lifecycle of an angiosperm is to ensure what?
(A) Species continuation via sexual reproduction
(B) Synthesis of organic nutrients via active leaf photosynthesis
(C) Direct absorption of liquid water from atmospheric moisture
(D) Firm mechanical anchorage of the mature plant to the soil

199. Identify the correct statement regarding fruit ripening.
(A) It makes the fruit less appealing to seed-dispersing animals.
(B) It involves the conversion of starches to simple sugars.
(C) It is inhibited by the hormone ethylene.
(D) It causes the seeds to die.

200. What is the ultimate product of the complete reproductive cycle in flowering plants under favourable conditions?
(A) A completely sterile pollen grain unable to germinate
(B) An unfertilized dead flower lacking a functional ovary
(C) A single detached cotyledon resting on the soil surface
(D) A new sporophyte capable of eventual flowering

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153. Maize and castor are examples of plants where male and female flowers are present on the same plant. What is this condition called?
(A) Dioecious
(B) Monoecious
(C) Unisexual complete
(D) Cleistogamous

154. Some plants produce flowers that never open, ensuring strict self-pollination. What are such flowers called?
(A) Chasmogamous
(B) Cleistogamous
(C) Dioecious
(D) Geitonogamous

155. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Cleistogamous flowers invariably exhibit autogamy (self-pollination).
Reason (R): These flowers never open, preventing foreign pollen from reaching the stigma.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

156. The development of a seed directly from the diploid tissues of the ovule without fertilisation is an asexual process known as what?
(A) Parthenocarpy
(B) Apomixis
(C) Vegetative propagation
(D) Hybridisation

157. Which type of endosperm development is most common in angiosperms, where the primary endosperm nucleus undergoes repeated divisions without immediate cell wall formation?
(A) Cellular endosperm
(B) Helobial endosperm
(C) Free nuclear endosperm
(D) Cotyledonary endosperm

158. The liquid water found inside a tender coconut is an example of what?
(A) Liquid mesocarp
(B) Free nuclear endosperm
(C) Liquid seed coat
(D) Degenerated nucellus

159. In some seeds, remnants of the nucellus persist. This residual, persistent nucellus is called what?
(A) Perisperm
(B) Endosperm
(C) Testa
(D) Scutellum

160. Black pepper and beet seeds typically contain which persistent tissue?
(A) Tegmen
(B) Coleoptile
(C) Perisperm
(D) Hilum

161. A true fruit develops exclusively from which part?
(A) Thalamus
(B) Calyx
(C) Ovary
(D) Corolla

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162. The fleshy, edible part of a mango is anatomically the what?
(A) Epicarp
(B) Mesocarp
(C) Endocarp
(D) Thalamus

163. The phenomenon where a single seed contains more than one embryo is termed what?
(A) Polyembryony
(B) Parthenocarpy
(C) Apomixis
(D) Double fertilisation

164. Polyembryony is most commonly observed in which of the following groups of plants?
(A) Legumes
(B) Citrus fruits
(C) Cereals
(D) Cucurbits

165. Match the fruit in List I with its edible part in List II.
List I: Fruit
P. Apple
Q. Mango
R. Coconut
S. Tomato
List II: Edible Part
1. Mesocarp
2. Endosperm
3. Fleshy thalamus
4. Entire pericarp and placenta
Select the correct matching code:

must occur first to transfer male gametes to the stigma. Next, fertilisation takes place when gametes fuse inside the embryo sac. The resulting zygote divides to undergo embryo formation, which ultimately becomes packaged along with food reserves into a mature seed during seed formation.

11. (B) Double fertilisation
Double fertilisation is a specialized reproductive process unique to angiosperms involving two distinct fusion events. One male gamete fuses with the egg cell to perform syngamy, yielding a diploid zygote. Simultaneously, the second male gamete fuses with two polar nuclei to form a triploid primary endosperm nucleus, which later develops into nutrient-rich endosperm.

12. (B) Seed
Following successful double fertilisation inside the floral ovary, structural transformations take place within the flower. The fertilised ovule undergoes cellular proliferation and differentiation, eventually turning into a mature seed containing an embryo and stored nutrients. Meanwhile, surrounding ovary tissues simultaneously develop into a fruit structure designed to enclose and protect the seeds.

13. (A) Cotyledon
Cotyledons are specialized embryonic leaf structures within plant seeds that serve as primary food storage organs or absorptive structures. During seed germination, the nutrients packed within cotyledons, such as starches and proteins, are metabolised to nourish the growing embryo before the young shoot can emerge and begin independent photosynthetic food synthesis.

14. (C) Simple fruits
Simple fruits are defined botanically as fruits that develop from a single monocarpellary or syncarpous ovary located within a single flower. Regardless of whether they become fleshy at maturity, such as tomatoes, or remain dry, such as legumes, their development originates from one unified ovary structure rather than multiple separate carpels.

15. (B) I and III only
Seed dispersal plays a vital ecological role by transporting seeds away from parent plants. This process effectively prevents dense overcrowding around the parent, which reduces intense competition for water, light, and soil nutrients among emerging seedlings. Furthermore, dispersing seeds into broader environmental areas enables plant species to successfully colonise new terrestrial habitats.

16. (C) Germination
Seed germination is the physiological process through which a quiescent or dormant seed resumes active metabolic growth under favorable environmental conditions. Triggered by adequate hydration, oxygen supply, and suitable ambient temperature, the embryo swells, ruptures the seed coat, and initiates cellular division to develop a root radicle and shoot plumule.

17. (B) Endosperm
The endosperm is a specialized nutrient-storing tissue unique to angiosperm seeds, formed through triple fusion during double fertilisation. It accumulates essential carbohydrates, proteins, and lipids to supply vital nutrition to the developing embryo during seed maturation and often during early germination stages until photosynthetic seedling tissues become functionally self-sufficient.

18. (D) Dicots
Flowering plants, or angiosperms, are broadly categorized into monocotyledons and dicotyledons based on embryonic seed structures. Dicotyledons, commonly known as dicots, are characterized by seeds that possess two distinct embryonic seed leaves called cotyledons. Additional typical dicot features include net-like leaf venation, ringed vascular tissue arrangements, and tetramerous or pentamerous flowers.

19. (A) Vegetative propagation
Vegetative propagation is an asexual mode of plant reproduction in which new individuals arise directly from non-reproductive vegetative structures such as roots, stems, or leaves, without involving floral gametic fusion or seed production. Because cell division occurs exclusively through mitosis, the resulting offspring are genetically identical clones of the parent plant.

20. (C) Ethylene
Ethylene is a gaseous plant hormone that functions as a master regulator of fruit ripening. It accelerates physiological processes including tissue softening through cell wall hydrolysis, starch conversion into soluble sugars, and chlorophyll

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seeds; parthenocarpic fruits develop without fertilisation and are naturally seedless.

106. (D) A complete lack of effective pollinators
Fruit set in flowering plants generally depends on successful pollination and subsequent fertilisation. When compatible biological or physical pollinators are absent, pollen transfer to stigmas fails to occur. Without fertilisation, the ovary does not receive the hormonal signals required for development, leading to unfertilized flower drop without fruit set.

107. (A) Abscission
Abscission is the physiological process by which plants shed unneeded or damaged organs, such as leaves, petals, unfertilized flowers, or immature fruits. It involves enzymatic degradation of middle lamellae and cell walls within a specialized abscission zone at the base of the organ stalk, regulated by plant hormones like ethylene.

108. (C) Three
The pericarp, or fruit wall, develops from the ovary wall after fertilisation. In fleshy fruits, it typically differentiates into three distinct structural layers: the outermost protective skin called the epicarp, the middle edible or fibrous fleshy layer called the mesocarp, and the innermost layer called the endocarp surrounding the seed.

109. (D) Endocarp
In drupaceous fruits like mangoes, peaches, and plums, the pericarp differentiates into three anatomical zones. The endocarp is the innermost layer directly enclosing the seed. In a drupe, the endocarp becomes heavily lignified, hard, and stony to physically protect the enclosed seed embryo against environmental damage and seed predators.

110. (A) II, I, III
Fruit classification follows anatomical structural complexity. A simple fruit (like mango) develops from a single flower with a monocarpellary or syncarpous ovary. An aggregate fruit (like strawberry) forms from a single flower possessing multiple separate carpels. A composite fruit (like pineapple) arises from an entire inflorescence composed of multiple flowers.

111. (B) Thalamus
An apple is classified botanically as a pome, which is a false or accessory fruit. The true ovary wall forms the central cartilaginous core containing seeds, whereas the edible, fleshy outer part consumed by humans develops from the enlarged, swollen thalamus tissue that grows around the central floral ovary.

112. (B) An entire inflorescence
A composite or multiple fruit develops from an entire inflorescence rather than an individual flower. In this development, all the closely clustered flowers along with their peduncles, floral bracts, and perianth tissues fuse together into a single, cohesive, fleshy fruit structure, as seen in pineapple, jackfruit, and fig species.

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113. (A) Composite fruits
Jackfruit and pineapple are classical examples of composite, or multiple, fruits. Rather than developing from a single isolated flower, they form from an entire dense inflorescence. As development proceeds, individual floral ovaries, floral axis tissues, and surrounding persistent bracts fuse completely into a unified, large fleshy composite fruit structure.

114. (C) Balsam
Balsam plants exhibit an explosive dispersal mechanism, or autochory, to scatter their seeds. As the mature fruit pod dries, mechanical tension builds up unevenly within the fruit pericarp walls. Upon the slightest disturbance, the fruit ruptures suddenly and coils inward, forcefully flinging seeds outward across considerable distances from the parent plant.

115. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Seeds dispersed by wind exhibit physical adaptations, such as lightweight structures, pappus hairs, or expanded wings. These aerodynamic modifications increase surface area relative to weight, allowing seeds to remain suspended in air currents for longer durations. Consequently, wind currents transport these buoyant seeds over vast geographic distances to populate new habitats.

116. (C) Cotyledons
During epigeal germination in dicot plants, the hypocotyl elongates and pulls the cotyledons above the soil surface. Exposed to sunlight, these cotyledons expand, turn green, and temporarily perform photosynthesis as the initial functional leaves, nourishing the developing seedling

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At the base rests the swollen ovary containing the ovules.

31. (C) Ovary
The ovary is the enlarged, basal region of the carpel or pistil that houses one or more protective ovules attached to placental tissue. Within these ovules, female gametes are produced and fertilisation occurs. Post-fertilisation, the ovary wall develops into the fruit wall or pericarp, protecting the developing seeds inside.

32. (A) Filament
The filament is the long, slender stalk portion of a stamen that supports the terminal fertile anther. By elevating the anther above surrounding floral organs, the filament positions pollen grains advantageously for effective transfer by abiotic wind currents or visiting biotic pollinators to facilitate successful cross-pollination or self-pollination mechanisms.

33. (B) To protect the flower bud during early development
The calyx, composed of individual sepals, forms the outermost protective floral whorl. Its main physiological role is to protect delicate, developing inner floral organs such as petals, stamens, and carpels from mechanical injury, desiccation, and pest attack during early bud stages before the flower expands and opens up fully.

34. (A) Ovule integuments
Following fertilisation in flowering plants, the ovule undergoes structural modification to transform into a seed. The protective outer layers surrounding the ovule, known as integuments, dry out and harden to form the seed coat, composed of the outer testa and inner tegmen, which shields the dormant embryo from damage.

35. (C) Assertion (A) is true but Reason (R) is false.
Self-pollination involves transferring pollen grains to a stigma on the same individual plant, preserving parental genetic traits in offspring. However, self-pollination does not occur between flowers of two different plants; transfer between different plants represents cross-pollination. Therefore, the statement explaining pollen movement across separate individuals is factually inaccurate.

36. (C) Bisexual flowers
Flowers that contain both functional male reproductive organs, represented by stamens, and functional female reproductive organs, represented by carpels or pistils, within the same individual blossom are classified as bisexual flowers. Also known as perfect or hermaphroditic flowers, examples include species like mustard, china rose, and pea plants.

37. (A) Unisexual
Flowers that possess either male stamens or female pistils, but never both reproductive organs within the same individual floral structure, are defined as unisexual flowers. Staminate flowers contain only stamens, whereas pistillate flowers contain only pistils. Species like papaya, watermelon, and cucumber typically produce these distinct unisexual floral organs.

38. (D) Cross-pollination
Cross-pollination, or xenogamy, is the transfer of pollen grains from the anther of a flower on one plant to the receptive stigma of a flower on a genetically distinct plant of the same species. This mechanism promotes genetic recombination and increases genetic diversity, enhancing population adaptability to environmental changes.

39. (A) Light, non-sticky pollen grains
Wind-pollinated flowers, or anemophilous species, display specialized adaptations for airborne pollen transport. They produce immense quantities of light, smooth, and non-sticky pollen grains that easily float in air currents. Furthermore, these flowers lack bright colours, sweet scents, and nectar, which are adaptations tailored instead for attracting animal pollinators.

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40. (C) Aquatic plants like Hydrilla
Water pollination, or hydrophily, is a relatively rare pollination mechanism predominantly observed in certain aquatic angiosperm species. Submerged or floating aquatic plants, such as Hydrilla and Vallisneria, utilize water currents to carry released pollen grains directly to receptive stigmas, facilitating gametes reaching female reproductive organs underwater or at the water surface.

41. (C) Stigma
The stigma is the uppermost, terminal region of the carpel specifically modified to act as a landing platform for pollen grains. It often features sticky surfaces, glandular hairs, or specialized secretions that capture air-borne or insect-borne pollen, providing essential hydration

85. (A) P-2, Q-4, R-1, S-3
Pollination mechanisms are classified botanically by their pollinating vectors: anemophily refers to wind pollination, hydrophily denotes water pollination, entomophily describes insect pollination, and ornithophily signifies bird pollination. Each mechanism reflects specific structural adaptations evolved by flowers to effectively interact with their corresponding abiotic or biotic vector.

86. (B) Stamens and carpels maturing at different times
Dichogamy is a floral adaptation that prevents self-pollination in bisexual flowers by staggering the maturation timing of male and female reproductive organs. Whether stamens mature first (protandry) or carpels mature first (protogyny), temporal separation prevents self-pollen from fertilizing receptive stigmas on the same flower, promoting beneficial cross-pollination mechanisms.

87. (D) Micropyle
The micropyle is a minute pore retained in the seed coat, originating from the tiny opening in ovule integuments. During seed imbibition and germination, the micropyle functions as an essential channel allowing water and oxygen to penetrate the hard outer seed coat, activating embryonic cellular metabolic pathways for root emergence.

88. (B) Drupe
A drupe is a simple fleshy fruit derived from a monocarpellary superior ovary, characterized by a distinct three-layered pericarp. In mangoes and peaches, the pericarp comprises a thin outer epicarp, a fleshy middle mesocarp, and a hard, stony inner endocarp that encloses and protects the single seed inside.

89. (C) Carbon dioxide
Seed germination requires three primary environmental conditions: adequate moisture for hydration, oxygen for aerobic cellular respiration, and a favorable temperature for optimal enzyme activity. Carbon dioxide is not required for germination; in fact, elevated levels of carbon dioxide can inhibit embryonic respiration and delay seed sprouting processes.

90. (B) Stigma, Style, Ovary, Micropyle
Following pollination, a germinating pollen tube traverses a specific anatomical pathway to achieve double fertilisation. The pollen grain first attaches to the receptive stigma, after which the pollen tube elongates down through internal style tissues to reach the ovary cavity, finally entering the ovule via the micropylar pore.

91. (B) Water
Coconut seeds exhibit specialized adaptations for hydrochory, or seed dispersal via water currents. The fibrous middle layer of the fruit pericarp, known as the mesocarp, traps air pockets, providing buoyant floating capabilities. This structural feature enables coconut fruits to travel long distances across ocean currents before washing ashore to germinate.

92. (A) Storage of food reserves
In dicotyledonous seeds, cotyledons serve as primary food storage structures for embryonic development. During seed maturation, nutrients transferred from the endosperm accumulate within the two thick cotyledons. Upon germination, stored starches, proteins, and lipids are enzymatically broken down to nourish the growing radicle and plumule until leaves perform photosynthesis.

93. (C) Scutellum
In monocot seeds of the Poaceae family, such as maize and wheat, the single cotyledon is modified into a large, shield-shaped structure known as the scutellum. Positioned between the rich starchy endosperm and the embryonic axis, the scutellum absorbs mobilized nutrients from the endosperm and transfers them to the growing seedling.

94. (D) Coleoptile
The coleoptile is a conical, protective sheath covering the delicate embryonic shoot tip or plumule in monocot seeds like grass species. During germination, the coleoptile pushes through the soil ahead of the emerging shoot, shielding soft leaf primordia from mechanical abrasion until it breaks open above ground to expose young leaves.

95. (B) I and III only
Vegetative propagation is a form of asexual reproduction where new plants arise from non-reproductive organs like stems, roots, or leaves,

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53. (D) Gram
Gram, or chickpea, belongs to the Fabaceae family and produces dicotyledonous seeds characterized by two thick cotyledons within each seed. In contrast, cereal crops like wheat, rice, and maize are monocotyledonous plants whose seeds contain only a single cotyledon known as a scutellum alongside an abundant starchy endosperm storage tissue.

54. (D) Maize
Maize is a member of the Poaceae grass family and produces monocotyledonous seeds containing a single shield-shaped cotyledon called a scutellum. Conversely, leguminous and brassica crops like peas, beans, and mustard are dicotyledonous plants whose embryonic seeds possess two distinct cotyledons functioning as primary food storage structures.

55. (A) I and II only
Endosperm is a triploid tissue resulting from triple fusion during double fertilisation, serving to supply vital nutrients to developing plant embryos. While endosperm is completely consumed prior to seed maturity in exalbuminous seeds such as peas and beans, it remains retained as a persistent nutrient reservoir in mature albuminous seeds like castor, maize, and wheat.

56. (B) Leaves
Bryophyllum plants exhibit a specialized mechanism of natural vegetative propagation occurring through adventitious buds located along notch margins of their fleshy leaves. When mature leaves fall onto moist soil, these foliar buds sprout to form tiny plantlets with roots and shoots that detach to grow independently into mature adult plants.

57. (D) Cutting
Stem cutting is an artificial vegetative propagation technique where a section of stem containing node buds is removed from a parent plant and placed into moist soil or growing media. Under suitable environmental conditions, adventitious roots develop at the buried stem node, establishing an independent, genetically identical clone plant.

58. (A) Parthenocarpy
Parthenocarpy refers to the natural or artificially induced development of a fruit from a floral ovary in the absence of fertilisation. Because fertilisation does not take place to form zygotes, parthenocarpic fruits are naturally seedless, as seen commercially in cultivated crop varieties of banana, pineapples, grapes, and seedless watermelons.

59. (C) Cytokinin
Cytokinins are plant growth hormones that primarily stimulate cell division, or cytokinesis, in plant tissues. They are present in high concentrations within regions experiencing rapid cell division and growth, such as developing seeds, fruits, and root tips, working synergistically with auxins to regulate tissue differentiation and organ development.

60. (D) Abscisic acid
Abscisic acid is a major inhibitory plant hormone involved in regulating stress responses and developmental growth cessation. It induces and maintains seed dormancy, preventing premature germination under unfavourable environmental conditions. Furthermore, abscisic acid promotes stomatal closure during drought stress and accelerates leaf abscission and tissue senescence in plants.

61. (D) White petals and strong fragrance
Flowers adapted for pollination by nocturnal insects like moths display specific evolutionary traits. Because visual colour detection is reduced at night, these flowers feature white or pale petals that reflect moonlight, combined with intense fragrant floral odors emitted in the evening to guide nocturnal pollinators to nectar sources.

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62. (B) Fertilisation
Following successful pollination, where pollen lands on a receptive, compatible stigma, fertilisation must take place for seed formation to proceed. The germinating pollen tube delivers male gametes into the ovule inside the floral ovary, where double fertilisation yields a diploid zygote and primary endosperm nucleus, initiating true seed development across plant species.

63. (B) To prevent self-pollination
Emasculation is an essential procedural step in controlled plant hybridisation, involving the selective removal of immature anthers from a bisexual flower bud prior to pollen release. Removing the male organs prevents self-pollination, allowing plant breeders to manually

breakdown alongside pigment synthesis. Ethylene autocatalytically stimulates its own production during climatic fruit development, promoting uniform fruit maturation.

21. (A) Pollination is pollen transfer, while fertilisation is the fusion of gametes.
Pollination and fertilisation represent two distinct sequential stages in plant reproduction. Pollination is the physical transfer of pollen grains from anthers to receptive stigmas, relying on physical or biological vectors. In contrast, fertilisation is a cellular biochemical process occurring internally within the ovule, where the male gamete fuses with the egg nucleus.

22. (D) Insect pollination
Flowers adapted for insect pollination, or entomophily, display evolutionary traits tailored to attract biotic animal vectors. Brightly coloured petals provide visual signals, while nectaries produce sugar-rich fluid rewards. These adaptations entice foraging insects like bees and butterflies to visit the flower, thereby facilitating the accidental transfer of sticky pollen between floral structures.

23. (B) Hybridisation
Hybridisation is an agricultural breeding technique involving the controlled cross-pollination of two genetically distinct plant varieties, lines, or species. Plant breeders selectively transfer pollen from one parent to another to combine beneficial traits, such as disease resistance, higher yield, or climate resilience, creating superior hybrid offspring that exhibit hybrid vigor.

24. (C) By enabling essential fruit and seed set in crop plants
Pollination plays an indispensable economic role in modern agriculture by enabling successful sexual reproduction in crop plants. Transferring functional pollen to receptive stigmas initiates seed and fruit formation. Many major economic crops, including fruits, nuts, vegetables, and oilseeds, depend directly on effective pollination to achieve optimal crop yields and quality.

25. (A) I and III
Bees serve as essential biotic pollinators in agricultural and natural ecosystems, cross-pollinating a wide variety of crop species and flowering plants while foraging for food. Additionally, honeybees produce commercially valuable products such as honey and beeswax within their colonies. Bees transfer pollen from anthers to stigmas, rather than in reverse.

26. (B) Premature flower drop
Reproductive disorders in flowering plants often manifest as physical disruptions in floral development or fertilisation mechanisms. Premature flower drop, or flower abscission, occurs when stress factors, hormonal imbalances, or poor pollination cause unfertilised or damaged flowers to detach before fruit set can occur, negatively impacting the plant's reproductive output.

27. (C) Parthenocarpy
Parthenocarpy is the botanical phenomenon where a fruit develops from a floral ovary without undergoing fertilization. Because fertilization does not occur, the resulting fruits are naturally seedless. This process can occur naturally in plants like bananas or be artificially induced using plant growth regulators such as auxins and gibberellins.

28. (A) It produces genetic variation in plant populations.
The primary ecological significance of sexual reproduction in flowering plants lies in its capacity to generate genetic variation within populations. Through genetic recombination, independent assortment during meiosis, and cross-fertilisation, new gene combinations are produced. This genetic diversity enables plant populations to adapt to changing environmental conditions and resist emerging pathogens.

29. (C) Petals
The corolla is the second floral whorl located inside the outermost calyx, and its individual structural units are known as petals. Petals are frequently pigmented, fragrant, and variable in shape to attract biological pollinators like insects and birds, while physically enclosing and protecting the inner reproductive stamens and carpels.

30. (B) II, III, I
The carpel or pistil exhibits a vertical structural organization from top to bottom. At the apex sits the stigma, which serves as a sticky surface for pollen reception. Beneath the stigma lies the elongated style, through which pollen tubes grow.

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female reproductive whorl made of individual carpels or pistils. In contrast, the calyx consists of sepals, the corolla consists of petals, and the androecium consists of stamens, making gynoecium-carpels the correct structural pairing.

75. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
The pollen grain represents the male gametophyte in angiosperm plants because it develops from a haploid microspore and houses male gametes. Within the pollen tube, the generative cell undergoes mitosis to form two male gametes required for fertilisation, demonstrating that the pollen structure functions as the male gamete-producing organism phase.

76. (A) Embryo sac
In angiosperms, the female gametophyte is structurally known as the embryo sac, located internally within the ovule. A typical mature embryo sac develops from a functional megaspore through free-nuclear divisions and cellular organization, resulting in a 7-celled, 8-nucleate structure that includes an egg apparatus, central cell, and antipodal cells.

77. (D) Exine
The exine is the outer, tough protective wall layer of a pollen grain, composed of sporopollenin, one of the most chemically resistant biological polymers known. Sporopollenin enables the pollen grain to withstand harsh environmental conditions, such as high temperatures, strong acids, and enzymatic degradation, protecting delicate male genetic material.

78. (B) Water (moisture)
Water absorption, or imbibition, is an indispensable environmental prerequisite for seed germination. Rehydration hydrates dry embryonic tissues, softens tough seed coats, and activates metabolic enzymes necessary to digest stored food reserves. This enzymatic activity fuels cellular division and expansion, allowing the embryo radicle and plumule to emerge.

79. (D) Primary endosperm nucleus
Triple fusion is a core component of double fertilisation in flowering plants, wherein a haploid male gamete enters the central cell of the embryo sac and fuses with the diploid secondary nucleus. This fusion event yields a triploid primary endosperm nucleus, which divides to form endosperm tissue supplying nutrients.

80. (A) Dehiscence
Anther dehiscence is the physiological process involving the splitting or opening of a mature anther wall along specific longitudinal lines, pores, or valves. This mechanism releases mature pollen grains into the environment, enabling physical or biological pollinating agents to transport pollen to receptive floral stigmas for sexual reproduction.

81. (D) Micropylar end
Within a mature 7-celled embryo sac, the egg apparatus is specifically positioned at the micropylar end. It consists of three distinct haploid cells: a single female egg cell flanked by two specialized synergid cells. This strategic micropylar placement facilitates the entry and reception of the elongating pollen tube during fertilisation.

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82. (B) Synergids
Synergids are specialized haploid cells located adjacent to the egg cell at the micropylar end of the embryo sac. They feature a prominent filiform apparatus that secretes chemotropic signaling molecules. These chemical guidance cues direct the approaching pollen tube through the micropyle into one of the synergids to release male gametes.

83. (A) Increased genetic variation among offspring
Cross-pollination offers substantial evolutionary benefits by combining genetic material from two distinct parent plants. Recombination during meiosis and cross-fertilisation yields novel allele combinations, increasing genetic diversity within offspring populations. Enhanced genetic variation improves overall fitness, disease resistance, and adaptability to fluctuating environmental stresses compared to uniform self-pollinated progeny.

84. (D) Papaya
Papaya is a dioecious or unisexual plant species where male staminate flowers and female pistillate flowers are produced on separate individual plants. Because individual papaya flowers lack either male or female organs, self-pollination within a single flower is structurally impossible, making cross-pollination obligate for fruit and seed production.

and chemical signals required to trigger pollen germination.

42. (B) Two
During pollen tube germination and growth, the generative cell within the pollen grain undergoes mitotic division to produce exactly two non-motile male gametes. As the pollen tube elongates down the style towards the ovule, it carries these two male gametes into the female embryo sac to perform double fertilisation.

43. (B) Secondary nucleus
Angiosperms undergo double fertilisation involving two male gametes inside the embryo sac. While one male gamete fuses with the haploid egg cell to yield a diploid zygote, the second male gamete moves to the center and fuses with the diploid secondary nucleus, forming a triploid primary endosperm nucleus.

44. (D) Zygote
The fusion of a haploid male gamete with a haploid female egg cell during double fertilisation is termed syngamy or generative fertilisation. This union restores the diploid chromosome number and forms a unicellular zygote. The zygote subsequently undergoes repeated mitotic divisions and differentiation to develop into an embryonic plant inside the seed.

45. (A) P-2, Q-3, R-4, S-1
Following fertilisation, floral structures undergo specific transformations. The enlarged ovary matures into the fruit wall, while ovules enclosed inside turn into seeds. Within the seed, the diploid zygote develops into the plant embryo, and the protective outer integuments surrounding the ovule modify to form the tough seed coat.

46. (A) Strawberry
An aggregate fruit develops from a single flower containing multiple free carpels, known as an apocarpous gynoecium. Each individual carpel forms a small fruitlet, and collectively these fruitlets cluster together on a common receptacle. Strawberry is a classic example, consisting of numerous tiny achenes embedded on an enlarged fleshy receptacle.

47. (D) Apple
False fruits, or accessory fruits, develop not only from the fertilized floral ovary but also incorporate non-carpellary accessory tissues such as the thalamus or floral tube. In an apple, the major edible fleshy tissue is derived from the swollen, enlarged thalamus that surrounds the central core containing the true ovary walls and seeds.

48. (A) Wing-like or hair-like seed structures
Wind-dispersed seeds, or anemochorous seeds, exhibit specialized anatomical adaptations designed to maximize aerodynamic drag and buoyancy in air currents. These include lightweight bodies equipped with flattened wing-like expansions or tufts of fine hair, allowing seeds to float effortlessly and travel considerable distances away from parent plants.

49. (C) Animals
Seeds of Xanthium and Urena are adapted for epizoochory, which is seed dispersal carried out on the exterior of animals. Their seed surfaces feature stiff hooks, spines, or barbed appendages that easily entangle in animal fur, feathers, or human clothing, ensuring long-distance transportation before dropping off in new environments.

50. (B) Absorption of water, Emergence of radicle, Emergence of plumule
Seed germination follows a physiological sequence. First, imbition takes place as the dry seed absorbs water, activating internal enzymes. Metabolic activation enables cell expansion, causing the root radicle to break through the seed coat first to anchor in soil. Finally, the shoot plumule emerges to grow upward towards sunlight.

51. (C) Radicle
The radicle is the embryonic root structure located at the lower end of the embryonal axis within a seed. During germination, it is always the first structure to break through the protective seed coat, growing downward into the soil to form the primary root system and absorb essential water and nutrients.

52. (A) Plumule
The plumule is the embryonic shoot tip located at the upper end of the embryonal axis in a seed. Following radicle emergence during germination, the plumule grows upward above the soil line, developing into the primary stem, leaves, and overall shoot system capable of performing photosynthesis to sustain plant growth.

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producing genetically identical clones of the parent plant. Vegetative propagation enables plants to bypass juvenile seed phases, allowing them to flower and produce fruit much faster than seed-grown plants.

96. (C) Grafting
Grafting is an artificial vegetative propagation technique in which tissues of two separate plants are joined together to grow as a single organism. The scion, containing desirable shoot buds, is attached to the rooted stock plant. Cambial alignment allows vascular continuity to establish, combining superior fruit traits with robust rootstocks.

97. (A) Auxin
Synthetic auxins, such as indole-3-butyric acid and naphthaleneacetic acid, are widely applied in horticulture to stimulate root initiation in stem cuttings. Auxins promote cell division and differentiation in cambial tissues, accelerating adventitious root formation at the cut base of stem cuttings to establish independent, cloned plant propagation.

98. (D) Parthenocarpy
Gibberellins are key phytohormones involved in regulating plant elongation and reproductive development. Exogenous application of gibberellins can induce parthenocarpy, triggering ovary wall growth and fruit expansion without requiring pollination or fertilisation. This hormonal treatment allows commercial production of seedless fruit varieties in crops such as grapes, tomatoes, and apples.

99. (A) Gametophyte
The life cycle of all angiosperms displays an alternation of generations between two distinct phases: a multicellular diploid sporophyte and a multicellular haploid gametophyte. The dominant sporophyte produces haploid spores via meiosis, which develop into reduced male and female gametophytes responsible for producing gametes to achieve sexual reproduction.

100. (B) Diploid sporophyte
In the angiosperm life cycle, the visible, prominent plant body—such as a mature tree or crop plant—represents the diploid sporophyte generation. This phase develops from a fertilised diploid zygote and features roots, stems, leaves, and flowers, ultimately undergoing meiotic cell division within microsporangia and megasporangia to generate haploid gametophytes.

101. (D) Germination - Formation of gametes
Germination refers to the growth process where a dormant seed activates and develops into a new seedling, rather than producing gametes. Gamete formation occurs much earlier in the reproductive cycle through microsporogenesis and megasporogenesis within floral anthers and ovules, rendering the pairing of germination with gamete formation incorrect.

102. (B) Small or inconspicuous petals
Entomophilous, or insect-pollinated, flowers possess adaptations designed to attract biotic insect vectors. These include large, brightly coloured petals, strong scents, sticky pollen grains, and nectar rewards. Small or inconspicuous petals are characteristic of wind-pollinated flowers, which do not need to visually attract insect pollinators for effective pollen transfer.

103. (A) Crossing different individuals to combine desired traits
Hybridisation is a fundamental plant breeding technique that involves controlled cross-pollination between genetically distinct individuals, varieties, or species. Plant breeders perform hybridisation to combine desirable traits from separate parent plants—such as high yield, disease resistance, and environmental stress tolerance—into single superior hybrid offspring for agricultural production.

104. (C) Increased crop yield through pollination
Honeybees and wild bees provide immense agricultural benefits through their foraging activities as key pollinators. As bees visit crop blossoms to collect nectar and pollen, they cross-pollinate flowers, ensuring successful fertilisation. Efficient bee pollination significantly increases seed set, fruit production, crop quality, and overall financial yield for farmers worldwide.

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105. (B) I, II and IV
True fruits develop exclusively from fertilized ovaries, whereas false fruits incorporate non-carpellary accessory floral structures such as the thalamus. Following fertilisation, the ovary wall matures into the protective fruit wall or pericarp. However, not all fruits contain

introduce chosen pollen from a selected male parent onto the receptive stigma.

64. (A) They ensure fertilisation, boosting fruit and seed yields.
Biotic insect pollinators, such as bees, butterflies, and beetles, are vital for agricultural economics because they transfer pollen between crop flowers. This transfer enables efficient fertilisation, leading to optimal fruit and seed development. Without insect pollination, crop yields and quality would decline significantly in insect-dependent agricultural species.

65. (B) I and III
Self-pollination occurs within the same flower or plant, operating independently of external biological vectors. In cleistogamous flowers, which remain permanently closed, self-pollination takes place reliably without opening. However, self-pollination reduces overall genetic diversity rather than increasing it, and it occurs strictly within the same species rather than between distinct species.

66. (D) Fully unisexual and incomplete
A flower lacking sepals, petals, and stamens, while containing only a pistil, is classified as incomplete because it lacks non-essential perianth whorls. Furthermore, because it possesses only female reproductive organs (pistil) and lacks male reproductive organs (stamens), it is structurally and functionally unisexual, specifically pistillate in nature.

67. (A) Banana
Commercially cultivated edible bananas represent a prime example of vegetative parthenocarpy. The fruits develop from the floral ovaries without requiring pollination or fertilisation, resulting in fleshy seedless fruits containing only minute, infertile ovule remnants embedded within the pulp, making them ideal for direct human consumption.

68. (D) A hard seed coat combined with low moisture content
Seeds survive harsh environmental conditions by entering a dormant state characterized by metabolic dormancy. This survival capability is enabled by a tough, protective seed coat derived from ovule integuments, combined with extreme dehydration down to ten to fifteen percent moisture content, protecting embryonic tissues against desiccation and extreme temperatures.

69. (B) Nectary gland
Nectary glands are specialized secretory floral tissues that produce nectar, a sugary fluid reward. Positioned strategically within flowers, nectaries attract biotic pollinators like insects, birds, and bats. As animals probe the flower to consume nectar, they brush against stamens and stigmas, facilitating pollen transfer between floral organs.

70. (B) II, III, IV, I
Sexual reproduction in plants follows a chronological order of cellular events. First, a landed pollen grain germinates on the receptive stigma. Next, it forms an elongating pollen tube that grows down the style. The pollen tube delivers male gametes to accomplish double fertilisation, ultimately forming a diploid zygote inside the ovule.

71. (D) Pedicel
The pedicel is the structural stalk that attaches an individual flower to the main inflorescence stem or plant axis. It supports the flower in space, positioning it for effective exposure to light, wind, or visiting animal pollinators, while housing vascular tissues that transport water, nutrients, and photosynthates to floral organs.

72. (A) Thalamus
The thalamus, or receptacle, represents the swollen, expanded apical portion of the flower stalk or pedicel. It serves as the physical foundation upon which all four concentric floral whorls—calyx, corolla, androecium, and gynoecium—are attached in specific arrangements such as hypogynous, perigynous, or epigynous patterns.

73. (C) Androecium
The androecium constitutes the third concentric floral whorl, situated inside the corolla, and represents the collective male reproductive structure of a flower. It is composed of individual units called stamens, each typically comprising a pollen-producing terminal anther supported by a slender filament stalk dedicated to male gamete production.

74. (C) Gynoecium - Carpels
A complete flower comprises four concentric whorls, each composed of specific basic structural units. The gynoecium represents the innermost

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until the plumule emerges and establishes true vegetative foliage leaves.

117. (B) The cotyledons being pushed above the soil surface
Epigeal germination is a mode of seed germination characterized by rapid elongation of the hypocotyl region. As the hypocotyl grows upward and curves into a hook, it pushes the cotyledons and shoot apex completely above the soil surface. Examples include castor, mustard, cotton, and French bean seeds.

118. (B) The cotyledons remaining beneath the soil surface
Hypogeal germination is a seed germination mode where the epicotyl elongates rapidly while the hypocotyl remains short. Consequently, the cotyledons remain buried beneath the soil surface inside the seed coat throughout germination. Common plant species demonstrating hypogeal germination include pea, gram, maize, and coconut seeds.

119. (C) Triploid (3n)
The primary endosperm nucleus (PEN) possesses a triploid (3n) chromosome number. It is formed during double fertilisation via triple fusion, where one haploid (n) male gamete fuses with the diploid (2n) secondary nucleus (or two haploid polar nuclei) in the central cell, giving rise to 3n endosperm tissue.

120. (B) Diploid (2n)
A normal plant zygote is a diploid (2n) cell formed through syngamy, the fusion of a haploid (n) male gamete carried by the pollen tube with a haploid (n) female egg cell inside the embryo sac. This fusion restores the species-specific diploid genetic complement in the resulting zygote.

121. (B) Two polar nuclei
Prior to double fertilisation, the large central cell of a mature 7-celled embryo sac contains two haploid polar nuclei situated near the center. During triple fusion, these two polar nuclei fuse together with one male gamete to form the triploid primary endosperm nucleus, which initiates endosperm development.

122. (C) Their embryo contains two distinct cotyledons
Monocotyledonous plants, or monocots, are defined by having seeds that possess only one single embryonic cotyledon, termed a scutellum in cereal grains. Describing a monocot seed as having two distinct cotyledons is factually incorrect, as possessing two cotyledons is the defining characteristic of dicotyledonous plant seeds.

123. (B) Endosperm - Food storage tissue
In seed anatomy, the endosperm functions as specialized food storage tissue that nourishes the developing embryo. In contrast, the radicle forms the future root, the plumule develops into the future shoot, and the micropyle is a small pore for water entry rather than a protective covering like the seed coat.

124. (D) Hilum
The hilum is a prominent scar visible on the seed coat marking the point of attachment where the ovule was connected to the ovary wall or fruit via the funicle stalk. Adjacent to the hilum lies the micropyle, a tiny pore through which water enters during seed germination.

125. (A) P-2, Q-1, R-4, S-3
Plants propagate vegetatively using specialized modified structures: potatoes reproduce through stem tubers with eyes, Bryophyllum produces plantlets along leaf margins, sweet potatoes propagate using root tubers, and ginger spreads via underground rhizomes. Each structure contains dormant vegetative buds capable of producing new, genetically identical offspring plants.

126. (B) Loss of genetic variation increases disease vulnerability
A significant disadvantage of vegetative propagation is that it relies on mitotic cell division, yielding offspring that are genetically identical clones of the parent plant. Lacking genetic variation, entire clonal populations share equal susceptibility to specific environmental stressors, insect pests, and disease pathogens, risking widespread crop failure.

127. (B) Emasculation
Emasculation is an essential procedural technique in plant breeding where anthers are manually removed from bisexual flower buds before they mature and dehisce. By eliminating pollen production in female parent flowers, emasculation prevents unwanted self-pollination, allowing plant breeders to cross-pollinate the

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visibility to pollinators and improving overall cross-pollination efficiency.

172. (B) Placentation
Placentation is the anatomical pattern in which ovules are attached to placental tissue within the floral ovary chamber. Common placentation types include marginal, axile, parietal, free-central, and basal arrangements. Placentation ensures structural support and efficient nutrient transport from maternal ovary tissues to developing ovules and seeds.

173. (B) Microsporogenesis
Microsporogenesis is the developmental process where diploid microspore mother cells located inside the microsporangia of an anther undergo meiotic cell division to produce haploid microspore tetrads. These microspores subsequently dissociate and form protective exine and intine wall layers, maturing into functional pollen grains that carry male gametic cells for plant reproduction.

174. (B) Megasporogenesis
Megasporogenesis is the cellular process inside the ovule nucellus where a diploid megaspore mother cell undergoes meiotic division to produce four haploid megaspores. Typically, three megaspores degenerate while one functional megaspore survives, undergoing megagametogenesis through free-nuclear divisions to form the mature 7-celled female gametophyte or embryo sac.

175. (B) I and III only
Hybridisation is an artificial plant breeding technique actively performed by humans to combine desirable genetic traits from distinct parents into hybrid offspring. It does not occur purely without human control in agricultural breeding programs, making statement II factually incorrect while statements I and III correctly describe hybridisation.

176. (B) The removal of anthers from a bisexual flower bud
Emasculation is the selective removal of immature, unopened anthers from a bisexual floral bud prior to pollen release. Performed using forceps or scissors in plant breeding, emasculation prevents unwanted self-pollination in the female parent plant, enabling controlled cross-pollination with selected pollen from a designated male parent.

177. (A) Vegetative propagation by stem cuttings
Vegetative propagation using stem cuttings relies on mitotic cell division to produce exact genetic clones of a superior parent plant. To rapidly propagate a disease-resistant rose plant while preserving its specific genetic traits, commercial growers utilize stem cuttings rather than seeds, which undergo meiotic recombination and introduce unwanted genetic variation.

178. (C) They wither and fall off
Following successful double fertilisation inside the ovule, metabolic resources shift toward developing the zygote and endosperm within the expanding ovary. Non-essential floral parts, including petals, sepals, and stamens, lose physiological utility, wither, and undergo abscission, falling off as the ovary transforms into a mature protective fruit.

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179. (B) Persistent sepals
Persistent sepals are sepals that remain attached to the developing fruit after fertilisation and persist through full fruit ripening. Unlike deciduous sepals that wither and fall off after double fertilisation, persistent sepals remain intact at the base or apex of fruits like tomatoes, brinjals, and guavas, offering continuous mechanical protection.

180. (A) P-4, Q-2, R-1, S-3
Each individual floral organ corresponds to a specific collective whorl term: individual sepals make up the outer calyx, individual petals form the corolla, individual stamens form the male androecium, and individual carpels comprise the female gynoecium, reflecting standard structural terminology in plant floral anatomy.

181. (C) Three
Inside a mature 7-celled angiosperm embryo sac, the egg apparatus is positioned at the micropylar end and consists of exactly three haploid cells. These three cells comprise a central female egg cell flanked by two specialized synergid cells equipped with filiform apparatuses that guide pollen tube entry during double fertilisation.

182. (C) Antipodals
Within a typical 7-celled, 8-nucleate angiosperm embryo sac, the three cells situated at the chalazal end, opposite the micropylar egg apparatus, are known as antipodal cells. These haploid cells function in nutrient transport from

efficiently trap lightweight, wind-borne pollen grains floating in air currents, compensating for the random nature of wind pollination compared to targeted biotic vector transfer.

139. (B) Through visual nectar guides and floral scents
Bees detect nectar rewards using sensory adaptations, including trichromatic visual perception extending into ultraviolet light spectrums and keen olfactory receptors. Flowers present visual nectar guides—patterns visible under ultraviolet light—alongside characteristic volatile organic floral scents to direct foraging bees toward central nectaries where pollen transfer occurs.

140. (C) Blossom end rot
Blossom end rot is a physiological disorder affecting floral and developing fruit tissues in solanaceous crops like tomatoes. Caused primarily by localized calcium deficiency during early fruit development, it leads to tissue necrosis at the blossom end, causing dark sunken lesions that impair successful fruit maturation and seed viability.

141. (A) Self-incompatibility
Self-incompatibility is a genetically controlled pre-zygotic mechanism in plants that prevents self-fertilisation. When self-pollen lands on a stigma of the same flower or plant, biochemical recognition systems inhibit pollen tube growth within the style, preventing self-fertilisation and promoting outcrossing to preserve high genetic variation within plant species.

142. (B) Maintaining genetic diversity within populations
Sexual reproduction contributes to ecological stability by generating and preserving genetic diversity within plant populations. Recombination during meiosis creates diverse allele combinations, enabling populations to adapt to changing environmental conditions, climate variations, and emerging pest pressures, ensuring long-term ecosystem resilience and species survival over geological time scales.

143. (C) Anther
The stigma, style, and ovary constitute the female reproductive organ of a flower, known as the carpel or pistil. In contrast, the anther belongs to the stamen, which is the male reproductive organ. Therefore, the anther represents the odd item among the listed female floral components.

144. (D) Grafting
Wind, water, and animals represent natural ecological vectors responsible for seed dispersal away from parent plants. In contrast, grafting is an artificial horticultural technique used for vegetative plant propagation rather than a mechanism for seed dispersal, making grafting the odd entry among the options provided.

145. (A) I, II and IV
Seed germination requires water for enzyme activation, oxygen for cellular respiration, and proceeds with radicle emergence before the plumule develops. Freezing temperatures inhibit enzyme activity and metabolic reactions, preventing successful germination. Therefore, statement III is factually incorrect regarding the temperature requirements for standard seed germination processes.

146. (C) Plumule
The plumule is the apical region of the embryonal axis in a seed, functioning as the precursor to the plant shoot system. During germination, the plumule grows upward above ground, developing into stems, leaves, and reproductive floral organs capable of carrying out photosynthesis to sustain future vegetative plant growth.

147. (A) Testa
The seed coat, derived from ovule integuments, typically consists of two protective layers. The outer layer is known as the testa, which is thick, hard, and leathery. The testa protects the dormant plant embryo from mechanical injury, chemical degradation, microbial entry, and excessive water loss in surrounding soils.

148. (C) Tegmen
The seed coat derived from double integuments comprises two distinct anatomical layers. While the outer thick layer is the testa, the inner layer is called the tegmen. The tegmen is a thin, delicate, membranous layer that directly encloses and shields the inner embryonic tissue and stored endosperm reserves.

149. (C) Bracts
Bracts are modified leaf-like structures situated at the base of a flower stalk or inflorescence axis. While often small and green, bracts in species like Bougainvillea become large and brightly

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trait
(B) The entire collection of chromosomes present inside a cell
(C) A specialized protein structure that carries genetic traits
(D) The nucleoplasmic fluid contained within the cell nucleus

13. In human beings, which sex chromosomes determine a male offspring?
(A) XX
(B) XY
(C) YY
(D) XO

14. Haemophilia and colour blindness are classic examples of which type of inheritance?
(A) Autosomal dominant pattern of inheritance
(B) Sex-linked recessive inheritance
(C) Y-linked holandric pattern of inheritance
(D) Co-dominant phenotypic pattern of inheritance

15. Choose the correct sequential order of genetic material organisation from smallest to largest.
(A) Nucleus → Chromosome → Gene → DNA
(B) DNA → Gene → Nucleus → Chromosome
(C) Gene → DNA → Chromosome → Nucleus
(D) Chromosome → Nucleus → DNA → Gene

16. A sudden, inheritable change in the DNA sequence of an organism is known as what?
(A) Adaptation
(B) Evolution
(C) Mutation
(D) Segregation

17. Why is genetic diversity important for the survival of a species?
(A) It ensures all individuals look identical to evade potential natural predators.
(B) It prevents any dangerous form of genetic mutation from ever occurring.
(C) It permanently stops the entire natural process of species evolution.
(D) It provides the raw material for adaptation to changing environments.

18. Human blood groups (A, B, AB, and O) are an example of which genetic phenomenon?
(A) Polygenic inheritance
(B) Incomplete dominance
(C) Multiple alleles
(D) Sex-linked inheritance

19. Down syndrome is a genetic disorder caused by an abnormality involving which structure?
(A) Sex-linked X chromosome structure
(B) Autosomal chromosome 21
(C) Sex-linked Y chromosome structure
(D) Extranuclear mitochondrial DNA

20. Match the terms in List I with their descriptions in List II.
List I:
P. Genotype
Q. Phenotype
R. Homozygous
S. Heterozygous
List II:
1. Two different alleles for a trait
2. Observable characteristics
3. Genetic makeup of an organism
4. Two identical alleles for a trait
(A) P-3, Q-2, R-4, S-1
(B) P-2, Q-3, R-1, S-4
(C) P-3, Q-2, R-1, S-4
(D) P-4, Q-1, R-3, S-2

21. The origin of new species from existing ones due to isolation and genetic divergence is called what?
(A) Extinction
(B) Fertilisation
(C) Hybridisation
(D) Speciation

22. Who proposed the theory of evolution by natural selection?
(A) Charles Darwin
(B) Gregor Mendel
(C) Jean-Baptiste Lamarck
(D) Hugo de Vries

23. Which concept forms the core of Darwin's theory of natural selection?
(A) Inheritance of acquired characters
(B) Use and disuse of organs
(C) Spontaneous generation
(D) Survival of the fittest

24. Organs that have a similar basic structure and origin but perform different functions are called what?
(A) Analogous organs
(B) Homologous organs
(C) Vestigial organs
(D) Rudimentary organs

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persistent nucellus. In these species, the central maternal nucellar tissue is not completely consumed during embryo sac expansion, persisting as a thin, nutrient-rich layer called perisperm surrounding the endosperm to nourish embryonic growth during germination.

161. (C) Ovary
A true fruit, or eucarp, develops exclusively from a fertilized floral ovary. Following double fertilisation, the ovary wall undergoes cell division and expansion to form the fruit pericarp, while non-carpellary floral organs like petals, stamens, and sepals wither and drop off, distinguishing true fruits from false accessory fruits.

162. (B) Mesocarp
In a drupaceous fruit like the mango, the pericarp differentiates into three distinct structural layers. The outer skin is the epicarp, and the inner hard, stony shell is the endocarp. The middle fleshy, succulent, and sweet layer located between them is the mesocarp, which constitutes the edible portion of mangoes.

163. (A) Polyembryony
Polyembryony is the biological phenomenon where a single seed contains more than one embryo. This can occur when multiple egg cells are fertilized within an embryo sac, or through adventitious embryony where somatic nucellar or integumentary cells divide and protrude into the embryo sac to develop into additional embryos.

164. (B) Citrus fruits
Polyembryony is commonly observed in Citrus species, such as lemons, oranges, and limes, as well as in mangoes. In Citrus seeds, maternal nucellar cells surrounding the embryo sac undergo mitotic division to form adventitious embryos alongside the normal zygotic embryo, resulting in seeds with multiple viable embryos.

165. (A) P-3, Q-1, R-2, S-4
Edible fruit tissues vary across plant species: the apple's edible portion is the fleshy thalamus, the mango's is the juicy mesocarp, the coconut's is the nutrient-rich endosperm, and the tomato's comprises the entire pericarp and central placental tissue, matching the structural classifications of edible fruit morphology.

166. (C) Pea
A seed that splits easily into two identical halves possesses two thick embryonic cotyledons, identifying it as a dicotyledonous seed. Pea plants belong to the Fabaceae family and produce dicot seeds with paired cotyledons. In contrast, cereal grains like wheat, rice, and maize are monocots containing a single cotyledon.

167. (B) Exalbuminous seed
Exalbuminous seeds, or non-endospermic seeds, are mature seeds in which the endosperm tissue formed during double fertilisation is completely consumed by the developing embryo before seed maturation. Consequently, food reserves are stored within the swollen cotyledons, as seen in leguminous species like peas, beans, and gram plants.

168. (B) Albuminous seeds
Albuminous seeds, or endospermic seeds, are mature seeds that retain persistent endosperm tissue at full maturity. Because the developing embryo does not completely consume the endosperm during seed development, this retained triploid tissue continues to serve as the primary nutrient store for germination, as seen in wheat, maize, and castor.

169. (B) Dormancy
Seed dormancy is a state of suspended growth and reduced metabolic activity that prevents viable seeds from germinating even under favorable conditions. This physiological mechanism prevents premature germination while the seed remains attached to the parent plant or during unfavorable seasons, allowing survival until optimal environmental conditions return.

170. (C) Gibberellin
Gibberellins are key plant hormones responsible for breaking seed dormancy and promoting germination. Upon seed hydration, gibberellic acid synthesis increases, stimulating aleurone layer cells to produce hydrolytic enzymes like alpha-amylase. These enzymes break down stored starch reserves in the endosperm into soluble sugars to nourish the growing embryo.

171. (B) Inflorescence
Inflorescence refers to the arrangement and distribution pattern of flowers on a specialized floral axis known as the peduncle. Classified primarily into racemose and cymose types based on main axis growth, inflorescence structure determines floral positioning, enhancing

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that fuels embryonic growth during germination and providing dietary carbohydrates for humans.

194. (C) Hull (Pericarp)
In caryopsis fruits of the grass family, such as wheat and maize, the fruit pericarp and seed coat fuse completely during development to form a thin, protective outer hull. This fused pericarp layer encloses the internal endosperm and embryo, protecting stored nutrients against desiccation, physical abrasion, and microbial pathogens.

195. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
The evolution of fruits and seeds provided significant adaptive advantages that fueled the evolutionary success of angiosperms. Fruits protect delicate developing seeds from herbivores and environmental hazards while providing mechanisms for seed dispersal via wind, water, or animals, ensuring species colonization across diverse ecological landscapes worldwide.

196. (B) Germination
Seed germination is the physiological transition where a dormant embryo absorbs water, resumes active metabolic respiration, and initiates cellular division and elongation. This process leads to the emergence of the root radicle and shoot plumule, transforming the dormant seed into an actively growing seedling capable of independent survival.

197. (C) The young shoot and primary root
During early seed germination, the developing primary root (radicle) and young shoot (plumule) rely entirely on stored organic food reserves within the cotyledons or endosperm. Mobilized starches, proteins, and lipids supply the energy and molecular building blocks required for cellular division until true photosynthetic leaves develop above ground.

198. (A) Species continuation via sexual reproduction
The primary biological purpose of flowers in angiosperm life cycles is to enable sexual reproduction, ensuring species survival across generations. Flowers house specialized structures that produce gametes, facilitate pollen transfer, enable double fertilisation, and protect developing ovules, culminating in the production of viable seeds and fruits for species propagation.

199. (B) It involves the conversion of starches to simple sugars.
Fruit ripening is a complex biochemical process regulated by ethylene that renders mature fruit appetizing for seed dispersers. During ripening, hydrolytic enzymes break down insoluble stored starches into soluble simple sugars like fructose and glucose, increasing sweetness, while cell wall degradation softens fruit tissue and chlorophyll breaks down.

200. (D) A new sporophyte capable of eventual flowering
The ultimate outcome of the complete sexual reproductive cycle in flowering plants is the creation of a viable seed housing an embryonic plant. Upon seed germination and establishment, this embryo grows into a new diploid sporophyte, which eventually reaches sexual maturity and produces flowers, completing the biological life cycle.

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surrounding nucellar tissues into the developing embryo sac before degenerating around the time of fertilisation.

183. (D) It is a diploid structure prior to fertilisation. The embryo sac represents the female gametophyte generation in angiosperms, which develops from a haploid functional megaspore through free-nuclear mitotic divisions. Because all cells within the mature 7-celled embryo sac—including the egg cell, synergids, and antipodals—are haploid prior to double fertilisation, describing the pre-fertilisation embryo sac as diploid is factually incorrect.

184. (B) To guide the entry of the pollen tube
Synergids are specialized haploid cells within the egg apparatus possessing finger-like wall ingrowths called the filiform apparatus. The filiform apparatus secretes chemotropic attractants that guide the elongating pollen tube into one of the synergids, enabling the release of male gametes directly into the embryo sac for double fertilisation.

185. (A) I, II and IV
Sexual reproduction in plants mixes genetic material via meiotic division and leads to seed formation. However, sexual reproduction in seed plants does not strictly require liquid water for gamete transfer; wind and animal pollinators transport pollen grains across dry environments, making statement III incorrect regarding general floral pollination requirements.

186. (C) Inhibiting self-pollen tube growth
Self-incompatibility is a genetically regulated physiological mechanism designed to prevent inbreeding depression. When pollen from a flower lands on its own stigma, S-gene recognition proteins activate biochemical pathways within style tissues that inhibit pollen tube elongation, preventing self-gametes from reaching the ovary and forcing outcrossing to maintain genetic health.

187. (C) Potato
Potato plants produce modified underground stems called tubers that function in vegetative propagation and nutrient storage. The eyes of a potato tuber are nodes containing axillary vegetative buds. When planted in soil, these buds sprout to form new shoots and adventitious roots, producing genetically identical clone potato plants.

188. (D) Lotus - Bat
Lotus is an aquatic plant whose emergent flowers are pollinated by diurnal insects like beetles and bees, rather than bats. In contrast, maize relies on abiotic wind pollination, Vallisneria utilizes water currents, and sunflowers depend on biotic insect vectors, making the lotus-bat pairing factually incorrect regarding natural plant pollinating agents.

189. (B) Epicotyl
In seed anatomy, the embryonal axis connects the plumule and radicle. The region of the embryonal axis situated above the attachment level of the cotyledons is called the epicotyl. The epicotyl terminates at its upper apex in the plumule, which elongates during seedling emergence to form the shoot system.

190. (B) Hypocotyl
The hypocotyl is the portion of the embryonic plant axis positioned below the level of cotyledonary attachment and above the radicle. During seed germination, hypocotyl elongation plays a crucial role in pushing the embryonic shoot or cotyledons upward through the soil, terminating inferiorly at the radicle tip.

191. (A) Hypogynous
In a hypogynous flower, the floral receptacle or thalamus is convex or conical in shape, positioning the ovary at the highest point as superior. The sepals of the calyx, petals of the corolla, and stamens arise sequentially below the ovary level, as seen in species like mustard, china rose, and brinjal.

192. (A) Epigynous
In epigynous flowers, the margin of the thalamus grows upward, completely enclosing the ovary and fusing with its wall. Consequently, the ovary becomes inferior, while other floral whorls—calyx, corolla, and stamens—arise from the top of the ovary, as observed in guava, cucumber, and sunflower ray florets.

193. (C) Starch
In cereal grains such as wheat, rice, and maize, the primary nutrient stored within the abundant endosperm tissue is starch. Starch is deposited as complex carbohydrate granules inside endosperm cells, serving as the main metabolic energy reserve

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pigmented to attract pollinators, while physically enclosing and protecting young floral buds prior to anthesis.

150. (B) Sessile
In floral terminology, a sessile flower lacks a supporting stalk or pedicel and attaches directly to the main stem or inflorescence axis. Because sessile flowers rest directly against plant axes, they rely on surrounding stem positioning for physical support, contrasting with pedicellate flowers that possess distinct pedicel stalks.

151. (B) A plant with male and female flowers on separate individuals
Dioecious plants are species in which individual plants are strictly single-sex, bearing either male staminate flowers or female pistillate flowers, but never both. This obligate separation of sexes across separate individuals prevents self-pollination entirely, enforcing cross-pollination to promote genetic diversity across generations in species like papaya and date palm.

152. (B) Dioecious
Papaya and date palm are prominent examples of dioecious plant species. Individual plants produce exclusively male or female flowers, necessitating pollen transfer from a male plant to a female plant for fruit set. Consequently, male and female plants must be grown together in agricultural orchards to ensure successful yield.

153. (B) Monoecious
Monoecious plants produce separate male and female unisexual flowers on the exact same individual plant body. In species like maize and castor, male flowers produce pollen while female flowers bear ovules on the same plant, preventing autogamy within a flower while permitting geitonogamy between different flowers on that plant.

154. (B) Cleistogamous
Cleistogamous flowers remain permanently closed throughout their development, never exposing their stamens and carpels to external elements or animal vectors. Anthers dehisce directly onto receptive stigmas inside the closed floral bud, guaranteeing self-pollination and seed set without relying on external pollinators, as seen in species like Commelina.

155. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Cleistogamous flowers exhibit obligate autogamy because their petals remain permanently closed, preventing flower opening. This structural isolation prevents foreign airborne or vector-borne pollen from entering, ensuring that the stigma receives pollen exclusively from anthers within the same closed flower, guaranteeing successful self-pollination and seed production.

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156. (B) Apomixis
Apomixis is a form of asexual reproduction in flowering plants where seeds develop directly from maternal ovule tissues without undergoing meiosis or fertilisation. Because gametes do not fuse, apomictic seeds yield offspring that are genetically identical clones of the parent plant, preserving hybrid traits across successive agricultural generations.

157. (C) Free nuclear endosperm
Free nuclear endosperm development is the most widespread pattern in angiosperms. The primary endosperm nucleus undergoes repeated mitotic divisions without immediate cytokinesis, creating a multinucleate cytoplasm surrounding a central vacuole. Cell wall formation occurs later, progressing from the periphery inward to complete cellular endosperm organization, as observed in coconuts.

158. (B) Free nuclear endosperm
The clear liquid water inside a tender coconut represents free nuclear endosperm, consisting of thousands of free nuclei suspended in liquid cytoplasm. As the coconut matures, cell walls form around these nuclei along the periphery, gradually depositing the firm white kernel, which represents the cellular endosperm tissue.

159. (A) Perisperm
Perisperm is the persistent, residual maternal nucellar tissue that remains in certain mature seeds after embryonic development. Unlike endosperm, which is formed via triple fusion during double fertilisation, perisperm is a diploid maternal tissue that stores additional nutrient reserves for the embryo, as seen in black pepper and beet seeds.

160. (C) Perisperm
Seeds of black pepper and beet are classic examples of perispermic seeds containing

CHAPTER 12

Heredity

1. What is the biological process of transferring traits from parents to their offspring called?
(A) Evolution
(B) Mutation
(C) Speciation
(D) Heredity

2. Which plant did Gregor Mendel primarily use for his foundational experiments on heredity?
(A) Solanum lycopersicum
(B) Rosa indica
(C) Pisum sativum
(D) Mangifera indica

3. In Mendel's experiments, a trait that remains hidden in the first filial (F_1) generation is known as what?
(A) Dominant trait
(B) Recessive trait
(C) Co-dominant trait
(D) Incomplete trait

4. The genetic constitution of an organism is called its genotype, whereas the observable physical traits are known as its what?
(A) Karyotype
(B) Prototype
(C) Somatotype
(D) Phenotype

5. An organism having two identical alleles for a particular trait is described by which of the following terms?
(A) Homozygous
(B) Heterozygous
(C) Hemizygous
(D) Multizygous

6. What is the phenotypic ratio in the F_2 generation of a standard monohybrid cross?
(A) 1:2:1
(B) 2:1
(C) 3:1
(D) 9:3:3:1

7. In a dihybrid cross involving two traits, what is the expected phenotypic ratio in the F_2 generation?
(A) 9:3:3:1
(B) 3:1
(C) 1:1:1:1
(D) 1:2:1

8. Which law states that the two alleles for a trait separate randomly during the formation of gametes?
(A) Law of Independent Assortment
(B) Law of Dominance
(C) Law of Natural Selection
(D) Law of Segregation

9. Mendel's Law of Independent Assortment can be best demonstrated by studying which type of cross?
(A) Test cross
(B) Dihybrid cross
(C) Back cross
(D) Monohybrid cross

10. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R).
Assertion (A): Chromosomes are structures found in the nucleus of a cell.
Reason (R): Chromosomes are composed entirely of proteins and contain no nucleic acids.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

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11. Which molecule carries the genetic information in most living organisms and has a double-helix structure?
(A) RNA
(B) Protein
(C) Lipid
(D) DNA

12. A gene is best defined as which of the following?
(A) A specific segment of DNA that controls a

stigma with chosen pollen from a selected male parent.

128. (B) To prevent unwanted pollen from reaching the stigma
In artificial hybridisation programs, emasculated floral buds are enclosed in protective bags made of butter paper, a procedure called bagging. Bagging prevents contamination of the receptive stigma by undesirable, airborne foreign pollen or insect-borne pollen, ensuring that fertilisation occurs only with desired pollen manually applied by plant breeders.

129. (A) Auxin
Exogenous application of auxin growth regulators, such as indole-3-acetic acid, to unpollinated flower pistils can artificially induce parthenocarpy. Auxins trigger cell division and expansion in ovary wall tissues, promoting normal fruit development without requiring pollination or fertilisation, resulting in seedless fruits in crops like tomatoes.

130. (D) They are preferred for fresh consumption and commercial processing
Seedless fruits produced through parthenocarpy offer high commercial value in agriculture. Consumers prefer seedless fruits like bananas, grapes, oranges, and watermelons for fresh eating due to convenience, while food processors prefer them for manufacturing jams, juices, and preserves without needing mechanical seed removal operations.

131. (B) A flower containing calyx, corolla, androecium, and gynoecium
In floral morphology, a complete flower is defined as a flower that possesses all four concentric floral whorls: the non-essential outer calyx and corolla, alongside the essential reproductive androecium and gynoecium. If a flower lacks any one of these four whorls, it is classified structurally as an incomplete flower.

132. (A) Perianth
When the calyx (sepals) and corolla (petals) of a flower show no clear structural differentiation in colour, texture, or form, the non-reproductive envelope is termed a perianth. Individual structural units of a perianth are called tepals, a feature common in monocot Families such as Liliaceae.

133. (B) Tepals
Tepals are the individual structural segments that comprise a perianth, occurring in flowers where distinct sepals and petals are absent. Tepals can be sepaloid (green and leaf-like) or petaloid (brightly coloured and attractive), protecting inner floral buds and aiding in pollinator attraction in species like lilies and tulips.

134. (C) Lily
Lilies are monocotyledonous flowering plants belonging to the Liliaceae family, characterized by flowers containing a perianth. In lily blossoms, sepals and petals are morphologically identical in size, shape, and bright pigmentation, forming six colorful tepals arranged in two whorls around the central reproductive organs.

135. (A) I and II only
The stamen represents the male reproductive unit of a flower, consisting of a slender supporting filament stalk and a terminal, typically bilobed, pollen-bearing anther. Stigma tissue located on the female carpel receives pollen grains during pollination, rather than the male stamen, making statement III factually incorrect regarding stamen structural function.

136. (B) To accommodate specific types of biological pollinators
Diversity in floral shape and structure represents evolutionary co-adaptation between flowering plants and their specific biological pollinators. Tubular, spur-shaped, or bell-shaped flowers fit the beak dimensions of specialized hummingbirds or the proboscis lengths of specific insects, ensuring efficient pollen deposition while excluding non-pollinating floral nectar thieves.

137. (A) Butea (Palash)
Butea monosperma, commonly known as Palash, produces flowers adapted for bird pollination, or ornithophily. Its flowers are large, sturdy, tubular, and brightly coloured red or orange, producing abundant dilute nectar that attracts avian vectors like sunbirds, which transfer heavy pollen grains while feeding on nectar rewards.

138. (D) Large, feathery stigmas
Anemophilous, or wind-pollinated, flowers feature large, feathery stigmas that project outside floral structures. These exposed feathery branches increase the available surface area to

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25. Arrange the following events of speciation in the correct logical sequence:
I. Natural selection acting differently in two populations
II. Reproductive isolation occurring
III. Geographical isolation of a population
IV. Accumulation of genetic variations
(A) III, IV, I, II
(B) I, II, III, IV
(C) IV, III, I, II
(D) III, I, IV, II

26. The preserved remains or traces of organisms that lived in the past are known as what?
(A) Fossils
(B) Vestiges
(C) Imprints
(D) Sediments

27. Which branch of biology involves the direct manipulation of an organism's genes using biotechnology?
(A) Systematic biological taxonomy
(B) Environmental organismal ecology
(C) Comparative animal physiology
(D) Applied genetic engineering

28. Which of the following is a practical example of a commonly inherited trait in humans?
(A) Ability to speak English
(B) Muscular strength built by exercise
(C) Attached or free earlobes
(D) Scar from an injury

29. What is the primary purpose of genetic counselling?
(A) To diagnose and treat acute bacterial infections clinically
(B) To perform surgical corrections for complex genetic disorders
(C) To directly alter and modify the DNA of unborn developing babies
(D) To advise families regarding the risks of inherited disorders

30. Consider the following statements regarding Mendel's experiments:
I. Mendel chose pea plants because they have many distinct, contrasting traits.
II. Mendel studied seven pairs of contrasting characters.
III. Mendel used humans as his primary model organism.
Which of the above statement(s) is/are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II, and III

31. The use of heredity principles in agriculture to produce improved seed varieties is an application of what?
(A) Selective breeding
(B) Natural selection
(C) Random genetic drift
(D) Adaptive radiation

32. If a pure tall pea plant (TT) is crossed with a pure dwarf pea plant (tt), what will be the appearance of the F_1 generation?
(A) All dwarf
(B) Half tall, half dwarf
(C) Medium height
(D) All tall

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33. In Mendelian genetics, the term 'allele' refers to what?
(A) A specific mode of eukaryotic cell division
(B) An alternative variant form of a gene
(C) The complete molecular structure of a chromosome
(D) A complex structural or enzymatic protein

34. Which of the following crosses will yield a 1:1 ratio of tall and dwarf plants?
(A) TT x tt
(B) Tt x Tt
(C) TT x TT
(D) Tt x tt

35. The wings of a bird and the wings of a bat are examples of which type of organs?
(A) Analogous organs
(B) Homologous organs
(C) Vestigial organs
(D) Endocrine organs

36. What is the fundamental physical and functional unit of heredity?
(A) Ribosome
(B) Mitochondrion
(C) Gene
(D) Nucleolus

37. During sex determination in humans, a sperm carrying a Y chromosome fertilising an egg results in what?
(A) A female child
(B) Twins

(D) P-2, Q-4, R-1, S-3

141. If a male is colour blind, from which parent did he inherit the gene responsible for the condition?
(A) Father
(B) Mother
(C) Both parents
(D) Neither, it is an acquired trait

142. The creation of "Bt Cotton" is an example of the application of which biological science?
(A) Taxonomy
(B) Genetic engineering
(C) Paleontology
(D) Classical Mendelian breeding

143. Which of the following is true about a dihybrid cross?
(A) It exclusively studies a single contrasting trait at any given time.
(B) It studies two traits simultaneously.
(C) It primarily involves crossing individuals of two different species.
(D) It consistently results in a standard 3:1 F_2 phenotypic ratio.

144. What defines a person as heterozygous for a blood group?
(A) Having genotype IA IA
(B) Having genotype ii
(C) Having genotype IB IB
(D) Having genotype IA i

145. What happens to the recessive trait in the F_1 generation of a Mendelian monohybrid cross?
(A) It remains hidden.
(B) It is permanently destroyed during fertilisation.
(C) It blends completely with the dominant trait in offspring.
(D) It is expressed fully in the physical phenotype.

146. Which term describes structures in different organisms that perform the same function but evolved independently?
(A) Homologous
(B) Analogous
(C) Vestigial
(D) Rudimentary

147. Fossils are primarily found in which type of rock?
(A) Igneous rock
(B) Metamorphic rock
(C) Volcanic rock
(D) Sedimentary rock

148. Which law of Mendel states that characteristics are inherited independently of each other?
(A) Law of Segregation
(B) Law of Dominance
(C) Law of Independent Assortment
(D) Law of Acquired Characteristics

149. An alteration in the DNA sequence that may lead to an observable change in phenotype is termed a:
(A) Recombination
(B) Crossing over
(C) Translocation
(D) Mutation

150. Consider the following statements regarding Down syndrome:
I. It is caused by an extra chromosome 21.
II. It leads to physical and cognitive developmental delays.
III. It is a sex-linked disorder.
Which of the above statement(s) is/are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II, and III

151. Which of the following best defines a gene?
(A) A DNA segment coding for a specific protein
(B) The complete observable physical appearance of an organism
(C) The entire macromolecular structure of a cell chromosome
(D) A specific type of functional protein found in the blood

152. What role do proteins play in the context of heredity?
(A) They serve directly as the primary chemical building blocks of cellular DNA.
(B) They store and carry the master genetic code directly within cell nuclei.
(C) They express genes to determine traits.
(D) They actively prevent any harmful genetic mutations from occurring in cells.

153. What is the phenotypic outcome when a plant with RRyy (Round, green seeds) is crossed with rrYY (wrinkled, Yellow seeds) in the F_1 generation?
(A) Round, green seeds
(B) Round, yellow seeds
(C) Wrinkled, yellow seeds
(D) Wrinkled, green seeds

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and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

51. Which field applies the principles of heredity to produce disease-resistant crops?
(A) Agricultural genetics
(B) Evolutionary palaeontology
(C) Systemic organismal ecology
(D) Biological classification taxonomy

52. Which of the following best describes 'mutation'?
(A) A predictable seasonal shift in an organism's daily dietary habits
(B) The normal physiological and physical growth of an organism over time
(C) The seasonal geographical migration of an entire species population
(D) A sudden and permanent change in the genetic material

53. If a person has the blood group genotype 'IA IB', what will be their blood group?
(A) A
(B) AB
(C) B
(D) O

54. A cross between a tall plant (TT) and a dwarf plant (tt) resulted in all tall plants. This indicates that tallness is which kind of trait?
(A) Recessive
(B) Incomplete
(C) Mutated
(D) Dominant

55. What does the term 'homozygous recessive' mean?
(A) Having two recessive alleles for a trait
(B) Having two different alleles for a trait
(C) Having two dominant alleles for a trait
(D) Having no alleles for a trait

56. Which of the following is NOT true regarding Charles Darwin's theory?
(A) It comprehensively explains the survival of the fittest in nature.
(B) It relies fundamentally on the mechanism of natural selection over time.
(C) It explains in detail how biological species undergo change over time.
(D) It states acquired traits are passed to offspring.

57. The process of forming a new species from a pre-existing species is known as what?
(A) Segregation
(B) Fertilisation
(C) Speciation
(D) Assimilation

58. Genetic counselling is most useful for predicting the likelihood of which of the following?
(A) Viral infections
(B) Bacterial diseases
(C) Inherited disorders
(D) Nutritional deficiencies

59. Which scientist is recognized as the "Father of Genetics"?
(A) Charles Darwin
(B) Louis Pasteur
(C) Gregor Mendel
(D) James Watson

60. Match the organisms in List I with the corresponding genetic or evolutionary concept they are associated with in List II.

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List I:
P. Pea plant
Q. Human blood
R. Finches
S. Bacteria
List II:
1. Natural selection observation
2. Multiple alleles
3. Basic laws of inheritance
4. Genetic engineering applications
(A) P-3, Q-2, R-1, S-4
(B) P-1, Q-2, R-3, S-4
(C) P-3, Q-1, R-2, S-4
(D) P-2, Q-3, R-4, S-1

61. A genetic disorder where blood does not clot properly is known as what?
(A) Anaemia
(B) Haemophilia
(C) Leukaemia
(D) Thalassemia

62. Which of the following is an example of an analogous organ pair?
(A) Human arm and whale flipper
(B) Bat wing and bird wing
(C) Dog paw and cat paw
(D) Bird wing and insect wing

63. Which part of the cell houses the chromosomes?
(A) Cytoplasm

(B) Mitochondria
(C) Nucleus
(D) Ribosome

64. If a trait is expressed in both the homozygous and heterozygous states, it is considered to be what?
(A) Recessive
(B) Co-dominant
(C) Sex-linked
(D) Dominant

65. The genetic constitution 'yy' in a pea plant (where Y is yellow and y is green) represents what?
(A) Homozygous recessive
(B) Homozygous dominant
(C) Heterozygous
(D) Hemizygous

66. The study of heredity and variations is broadly known as what?
(A) Cytology
(B) Genetics
(C) Evolution
(D) Ecology

67. Which of the following represents the genotypic ratio of a monohybrid cross in the F_2 generation?
(A) 3:1
(B) 1:2:1
(C) 9:3:3:1
(D) 1:1

68. What are the variations within a species primarily due to?
(A) Exposure to constant and uniform environmental temperatures
(B) Presence of completely identical genetic makeup across individuals
(C) Complete lack of natural selection pressure in the ecosystem
(D) Genetic mutation and recombination

69. Genetic engineering relies heavily on the manipulation of which molecule?
(A) Starch
(B) DNA
(C) Cellulose
(D) Haemoglobin

70. Consider the following statements regarding sex determination:
I. Females have two X chromosomes (XX).
II. Males have one X and one Y chromosome (XY).
III. The mother provides the Y chromosome to a male child.
Which of the above statement(s) is/are correct?
(A) I and II
(B) II and III
(C) I and III
(D) I, II, and III

71. The use of recombinant DNA technology to produce insulin in medicine is an example of what?
(A) Historical fossil record study
(B) Evolutionary natural selection
(C) Traditional selective breeding
(D) Genetic engineering

72. Which of the following terms refers to traits that are not inherited but develop during an organism's lifetime due to environmental influences?
(A) Acquired traits
(B) Inherited traits
(C) Genetic traits
(D) Mutated traits

73. Why is colour blindness more common in males than in females?
(A) The responsible mutated gene is located exclusively on the Y chromosome.
(B) The gene is X-linked recessive.
(C) Males completely lack an X chromosome in their biological genetic makeup.
(D) Males are typically much more exposed to intense and bright sunlight.

74. Which process provides the variations that act as the raw material for evolution?
(A) Respiration
(B) Digestion
(C) Transpiration
(D) Mutation

75. In Mendelian inheritance, what is the result of crossing two individuals that are heterozygous for a single trait (Aa x Aa)?
(A) 100% dominant phenotype
(B) 75% dominant and 25% recessive phenotype
(C) 100% recessive phenotype
(D) 50% dominant and 50% recessive phenotype

76. In humans, how many pairs of chromosomes are found in a normal diploid somatic cell?
(A) 22
(B) 23

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(C) 46
(D) 44

77. Which component of DNA forms the basis of genetic coding?
(A) Structural sugar-phosphate backbone chain
(B) Intermolecular double-helix hydrogen bonds
(C) Sequence of nitrogenous bases
(D) Associated cell membrane lipid attachments

78. Which of the following is considered an inherited trait?
(A) Learning a new language
(B) Riding a bicycle
(C) Building muscles by lifting weights
(D) Having dimples

79. The law of independent assortment is only applicable to which type of cross?
(A) Monohybrid cross
(B) Dihybrid cross
(C) Test cross
(D) Back cross

80. Consider the following statements about Down syndrome:
I. It is caused by an extra copy of chromosome 21.
II. It is a chromosomal disorder.
III. It only affects females.
IV. It is caused by a bacterial infection during pregnancy.
Which of the above statement(s) is/are correct?
(A) I and II
(B) II and IV
(C) I, II, and III
(D) III and IV

81. A couple has three daughters. What is the probability that their fourth child will be a boy?
(A) 25%
(B) 50%
(C) 75%
(D) 100%

82. Which environmental factor can sometimes determine the sex of offspring in certain reptiles?
(A) Environmental soil moisture levels
(B) Ambient availability of daylight
(C) Geographic altitude of the nest
(D) Incubation temperature

83. The occurrence of differences among the individuals of the same species is called what?
(A) Heredity
(B) Variation
(C) Selection
(D) Speciation

84. Which of the following serves as direct evidence that species have changed over long periods of time?
(A) DNA structure
(B) Blood typing
(C) Photosynthesis
(D) Fossils

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85. Select the correct sequence of trophic levels in a typical terrestrial food chain.
(A) Herbivore → Producer → Carnivore → Decomposer
(B) Producer → Herbivore → Carnivore → Decomposer
(C) Carnivore → Herbivore → Producer → Decomposer
(D) Decomposer → Carnivore → Herbivore → Producer

86. How many alleles for a particular trait are normally present in a single human gamete (sperm or egg)?
(A) One
(B) Two
(C) Three
(D) Four

87. An individual with the genotype 'Tt' for height in pea plants is known as what?
(A) Pure tall
(B) Pure dwarf
(C) Hybrid dwarf
(D) Hybrid tall

88. The traits that an organism manifests as a result of interaction between its genes and the environment form its what?
(A) Genotype
(B) Karyotype
(C) Ecotype
(D) Phenotype

89. Charles Darwin travelled on which ship to make his observations on evolution?
(A) HMS Endeavour
(B) HMS Beagle
(C) HMS Discovery
(D) HMS Challenger

90. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R).

(C) A child with Down syndrome
(D) A male child

38. Which sex chromosome is present in all normal human female egg cells?
(A) X chromosome only
(B) Y chromosome only
(C) Either X or Y chromosome
(D) Both X and Y chromosomes

39. Which of the following is NOT an inherited trait?
(A) Congenital eye colour pigmentation
(B) Naturally inherited human hair type
(C) Genetically determined ABO blood group
(D) Acquired knowledge of mathematics

40. Consider the following statements about DNA:
I. DNA stands for Deoxyribonucleic acid.
II. It is found primarily in the nucleus of a cell.
III. It consists of a single-stranded spiral structure.
IV. It carries instructions for the synthesis of proteins.
Which of the above statement(s) is/are correct?
(A) I, II, and III
(B) I, II, and IV
(C) II, III, and IV
(D) I, III, and IV

41. Which evolutionary evidence is obtained by studying the rock layers and the preserved hard parts of ancient organisms?
(A) Embryological evidence
(B) Morphological evidence
(C) Fossil evidence
(D) Biogeographical evidence

42. In a heterozygous individual (Tt), the trait that is expressed is the dominant one. Which law of Mendel does this describe?
(A) Law of Segregation
(B) Law of Independent Assortment
(C) Law of Inheritance
(D) Law of Dominance

43. Which of the following is a common sex-linked recessive disorder in humans?
(A) Red-green colour blindness
(B) Pulmonary tuberculosis infection
(C) Mosquito-borne malaria fever
(D) Acute bacterial cholera infection

44. What is the structural framework of a chromosome mainly composed of?
(A) Carbohydrates and lipids
(B) RNA and carbohydrates
(C) Lipids and proteins
(D) DNA and proteins

45. Down syndrome is technically known by which genetic term?
(A) Trisomy 21
(B) Trisomy 18
(C) Monosomy X
(D) XXY syndrome

46. The observable expression of the combined effect of a person's genetics and their environment is known as what?
(A) Karyotype
(B) Genotype
(C) Phenotype
(D) Haplotype

47. Which term defines the mechanism by which individuals with favorable variations survive and reproduce at higher rates?
(A) Genetic drift
(B) Artificial selection
(C) Mutation
(D) Natural selection

48. What does Mendel's law of independent assortment state?
(A) Alleles for distinct phenotypic traits are always inherited together in tight physical clusters.
(B) One specific allele in a heterozygous pair is strictly dominant over the alternative allele.
(C) Alleles of different traits assort independently during gamete formation.
(D) Maternal and paternal alleles permanently blend together during the process of fertilisation.

49. The forelimbs of a human, a dog, and a whale are examples of what?
(A) Functionally analogous structures
(B) Homologous structures
(C) Evolutionary vestigial structures
(D) Non-inherited acquired traits

50. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R).
Assertion (A): The sex of a child in human beings is determined by the father.
Reason (R): Males have one X and one Y chromosome, and can pass on either to the offspring.
(A) Both Assertion (A) and Reason (R) are true

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(C) Particles
(D) Molecules

103. If a person inherits an X chromosome from their father and an X chromosome from their mother, what will be their biological sex?
(A) Male
(B) Cannot be determined
(C) Depends on temperature
(D) Female

104. Which of the following is NOT an application of genetic engineering?
(A) Genetically producing pest-resistant agricultural crops
(B) Bio-manufacturing synthetic human insulin via bacteria
(C) Selective breeding of domestic dogs
(D) Genetically modifying bacteria to clean up environmental oil spills

105. Arrange the following steps of Mendel's experimental method in the correct order:
I. Cross-pollination of purebred parents
II. Selection of purebred pea plants
III. Allowing F_1 plants to self-pollinate
IV. Observation of F_2 generation traits
(A) II, I, III, IV
(B) I, II, III, IV
(C) II, III, I, IV
(D) I, III, II, IV

106. In an evolutionary context, which of the following provides the best evidence that birds and bats do NOT share a recent common ancestor for their wings?
(A) Their wings are homologous structures.
(B) Their wings are analogous structures.
(C) Both are capable of flight.
(D) Both are warm-blooded.

107. What type of cell division is responsible for the formation of gametes, ensuring they have half the number of chromosomes?
(A) Mitosis
(B) Meiosis
(C) Amitosis
(D) Budding

108. The F_2 phenotypic ratio of 9:3:3:1 is a hallmark of which of Mendel's laws?
(A) Mendelian Law of Dominance principle
(B) Mendelian Law of Allele Segregation
(C) Law of Independent Assortment
(D) Physical Law of Conservation of Mass

109. Which of the following sets represents pure lines for a specific trait?
(A) Tt and Tt
(B) TT and tt
(C) Tt and tt
(D) TT and Tt

110. Consider the following statements about speciation:
I. Geographic isolation leads to reproductive isolation.
II. Speciation is the process of extinction of a species.
III. Genetic drift plays a role in speciation.
Which of the above statement(s) is/are correct?
(A) I and II
(B) I and III
(C) II and III
(D) I, II, and III

111. Which blood group is known as the universal donor in the context of basic human genetics?
(A) A
(B) B
(C) AB
(D) O

112. The structural similarities between a human arm and a bird wing indicate what evolutionary relationship?
(A) They evolved from a common ancestor.
(B) They have no evolutionary relationship.
(C) They developed due to identical environments.
(D) They are both used for flying.

113. An organism's fitness, in a Darwinian sense, is primarily measured by its ability to do what?
(A) Survive and reproduce
(B) Defend itself from predators
(C) Migrate long distances
(D) Grow to a large size

114. Why is the inheritance of blood groups a good example of multiple alleles?
(A) Because human blood circulation fundamentally involves multiple cell types.
(B) Because the gene has three alleles: IA, IB, and i.
(C) Because the circulatory system contains many distinct types of blood vessels.
(D) Because individual blood group classifications gradually change with age.

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Assertion (A): Analogous organs provide evidence for evolution.
Reason (R): Analogous organs indicate common ancestry among different species.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

91. The double-helix model of DNA was famously proposed by which two scientists?
(A) Mendel and Darwin
(B) Watson and Crick
(C) Schleiden and Schwann
(D) Hooke and Leeuwenhoek

92. Which of the following traits in humans is generally considered recessive?
(A) Brown eyes
(B) Free earlobes
(C) Curly hair
(D) Blue eyes

93. A sudden change in the structure or number of chromosomes is an example of what?
(A) Speciation
(B) Mutation
(C) Segregation
(D) Assortment

94. Who wrote the influential book "On the Origin of Species"?
(A) Jean-Baptiste Lamarck
(B) Gregor Mendel
(C) Thomas Malthus
(D) Charles Darwin

95. What is the process by which modern crops have been developed by humans selecting desirable traits over many generations?
(A) Selective breeding
(B) Environmental natural selection
(C) Random population genetic drift
(D) Spontaneous natural mutation

96. Which term describes an organism that has inherited two identical alleles for a recessive trait?
(A) Completely homozygous dominant
(B) Homozygous recessive
(C) Genotypically heterozygous
(D) Phenotypically co-dominant

97. The concept that beneficial traits become more common in a population over successive generations is known as what?
(A) Random population genetic drift
(B) Meiotic chromosomal recombination
(C) Total biological extinction
(D) Natural selection

98. Genetic counselling is highly recommended for families with a history of which type of conditions?
(A) Nutritional diseases
(B) Communicable diseases
(C) Hereditary diseases
(D) Lifestyle diseases

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99. Which of the following describes the genotype of a human male?
(A) 44 autosomes + XX
(B) 44 autosomes + XY
(C) 22 autosomes + XX
(D) 22 autosomes + XY

100. Match the traits in List I with their typical dominance status in Mendelian pea plant genetics in List II.
List I:
P. Tall stem
Q. Dwarf stem
R. Round seeds
S. Wrinkled seeds
List II:
1. Dominant trait
2. Recessive trait
3. Dominant trait
4. Recessive trait
(A) P-1, Q-2, R-3, S-4
(B) P-2, Q-1, R-4, S-3
(C) P-1, Q-3, R-2, S-4
(D) P-3, Q-4, R-1, S-2

101. Which process guarantees that the number of chromosomes in the zygote remains the same as in the parents?
(A) Equational mitotic cell division
(B) Asexual prokaryotic binary fission
(C) Natural vegetative propagation methods
(D) Meiosis and fertilisation

102. What term did Mendel use to describe the traits that were passed down to offspring before the word "gene" was coined?
(A) Elements
(B) Factors

129. When does the process of crossing over, which leads to genetic variation, occur?
(A) During mitosis
(B) During meiosis
(C) During fertilisation
(D) During binary fission

130. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R).
Assertion (A): Genetic variation is essential for the evolution of a species.
Reason (R): It provides the raw material upon which natural selection acts.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

131. Which of the following is NOT an example of a homologous structure?
(A) Human arm
(B) Whale flipper
(C) Bat wing
(D) Insect wing

132. How many pairs of contrasting characters did Mendel study in pea plants?
(A) 5
(B) 7
(C) 9
(D) 11

133. The specific position of a gene on a chromosome is known as its:
(A) Allele
(B) Locus
(C) Centromere
(D) Telomere

134. Which branch of biology directly addresses the risk of passing on genetic disorders to offspring?
(A) Evolutionary palaeontology
(B) Genetic counselling
(C) Environmental biology and ecology
(D) Comparative vertebrate anatomy

135. What is the most likely outcome of prolonged geographical isolation between two populations of the same species?
(A) They will eventually merge back into a single unified population.
(B) They will undergo speciation into distinct species.
(C) They will completely stop mutating at the genomic level entirely.
(D) They will gradually become completely identical to one another.

136. In agricultural applications, what is the primary benefit of generating improved seed varieties through genetic principles?
(A) To make crop plants appear visually more attractive in fields
(B) To significantly reduce the overall amount of water on Earth
(C) To enhance crop yield and disease resistance
(D) To intentionally decrease the overall nutritional value of food

137. Which trait in pea plants did Mendel find to be dominant?
(A) Wrinkled seeds
(B) Green seeds
(C) Dwarf stems
(D) Round seeds

138. The theory that the environment "selects" the most advantageous traits for survival is attributed to whom?
(A) Gregor Mendel
(B) Charles Darwin
(C) James Watson
(D) Robert Hooke

139. Which genetic term describes the blending or partial expression of traits, such as pink flowers resulting from red and white parents?
(A) Classical complete dominance
(B) Incomplete dominance
(C) Inheritance by multiple alleles
(D) Sex-linked gene inheritance

140. Match the disease in List I with its genetic cause in List II.
List I:
P. Haemophilia
Q. Down syndrome
R. Colour blindness
S. Scurvy
List II:
1. Extra chromosome 21
2. X-linked recessive gene for blood clotting
3. Non-genetic (Vitamin C deficiency)
4. X-linked recessive gene for vision
(A) P-2, Q-1, R-4, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-4, Q-1, R-2, S-3

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115. What is the result of a cross between a homozygous dominant parent and a heterozygous parent (e.g., TT x Tt)?
(A) All offspring are dwarf.
(B) Half the offspring are dwarf.
(C) All offspring are tall.
(D) The offspring have a 3:1 ratio of tall to dwarf.

116. Which pair correctly identifies a genetic disorder and its inheritance pattern?
(A) Colour blindness - Autosomal dominant
(B) Haemophilia - Sex-linked recessive
(C) Down syndrome - Sex-linked dominant
(D) Malaria - Autosomal recessive

117. What is the term for a chromosome that is not a sex chromosome?
(A) Allosome
(B) Autosome
(C) Ribosome
(D) Centrosome

118. Which of the following is an example of an acquired trait?
(A) Blood type O
(B) Blue eye colour
(C) Attached earlobes
(D) A scar on the face

119. A DNA sequence reads A-T-G-C. What is the fundamental building block of this sequence called?
(A) Amino acid
(B) Nucleotide
(C) Fatty acid
(D) Monosaccharide

120. Consider the following statements about Charles Darwin:
I. He proposed the theory of Natural Selection.
II. He studied finches on the Galapagos Islands.
III. He discovered the structure of DNA.
IV. He coined the term 'Gene'.
Which of the above statement(s) is/are correct?
(A) I and II
(B) III and IV
(C) I, II, and III
(D) I, III, and IV

121. The basic principles of heredity are widely applied in medicine to do which of the following?
(A) Accurately predict the final adult height of an individual
(B) Effectively treat acute infectious bacterial diseases
(C) Surgically repair severely broken skeletal bones
(D) Screen for genetic defects

122. Which of the following crosses best demonstrates the Law of Segregation?
(A) TT x TT
(B) tt x tt
(C) Tt x Tt
(D) RRyy x rrYY

123. The total number of sex chromosomes in a normal human gamete is:
(A) One
(B) Two
(C) Twenty-two
(D) Twenty-three

124. Which condition is characterised by the presence of an extra 21st chromosome?
(A) Haemophilia
(B) Colour blindness
(C) Turner syndrome
(D) Down syndrome

125. The physical manifestation of an organism's genes, heavily influenced by the environment, is referred to as its:
(A) Phenotype
(B) Genome
(C) Karyotype
(D) Genotype

126. A recessive trait is expressed only when the genotype is what?
(A) Completely heterozygous
(B) Homozygous recessive
(C) Completely homozygous dominant
(D) Phenotypically co-dominant

127. If an individual has a genotype of 'Bb' for eye colour (where B is brown and b is blue), what will be their eye colour?
(A) Blue
(B) Green
(C) Brown
(D) Hazel

128. What provides the strongest direct evidence of the existence of extinct species?
(A) Analogous organs
(B) Homologous organs
(C) Vestigial organs
(D) Fossils

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154. If blood group inheritance is governed by alleles IA, IB, and i, which blood group is expressed only in a homozygous condition?
(A) A
(B) B
(C) AB
(D) O

155. Select the correct sequence of biological hierarchy from smallest to largest.
(A) Nucleotide → Gene → DNA → Chromosome
(B) Gene → Nucleotide → Chromosome → DNA
(C) Chromosome → DNA → Gene → Nucleotide
(D) Nucleotide → DNA → Gene → Chromosome

156. The practice of advising individuals and families affected by or at risk of genetic disorders is called:
(A) Medical physical therapy
(B) Genetic counselling
(C) Clinical psychotherapy
(D) Somatic cell gene therapy

157. Which organism provides classical evidence of natural selection in response to industrial pollution (industrial melanism)?
(A) Pea plants
(B) Peppered moths
(C) Galapagos finches
(D) Fruit flies

158. If a woman is a carrier for haemophilia (XHXh) and a man is normal (XHY), what is the probability that their son will have haemophilia?
(A) 0%
(B) 25%
(C) 50%
(D) 100%

159. Which physical feature in humans is a well-known example of a simple inherited genetic trait?
(A) Fluctuating human body weight
(B) Variable personal hair length
(C) Formation of skin calluses on hands
(D) Tongue rolling ability

160. Consider the following statements about natural selection:
I. It requires genetic variation within a population.
II. It leads to the accumulation of beneficial traits over generations.
III. It causes organisms to adapt to their environment.
IV. It is a completely random process without direction.
Which of the above statement(s) is/are correct?
(A) I, II, and III
(B) II, III, and IV
(C) I, II, and IV
(D) I, III, and IV

161. A cross between a red-flowered plant and a white-flowered plant yields all pink-flowered offspring. What does this demonstrate?
(A) Complete dominance
(B) Co-dominance
(C) Incomplete dominance
(D) Recessive inheritance

162. How does genetic diversity benefit an agricultural crop species?
(A) It ensures that all individual plants look completely identical for much easier harvesting.
(B) It guarantees that the entire agricultural crop ripens on the exact same calendar day.
(C) It completely prevents crop plants from producing viable seeds during their lifecycle.
(D) It reduces the risk of total crop failure from a single disease.

163. The structural unit of DNA consists of a sugar, a phosphate group, and a nitrogenous base. This unit is called:
(A) A nucleoside
(B) A nucleotide
(C) An amino acid
(D) A peptide

164. The term 'homozygous' is best represented by which of the following pairs?
(A) Tt
(B) AB
(C) Xy
(D) tt

165. The law of segregation is fundamentally based on the separation of what during cell division?
(A) Homologous chromosomes
(B) Multiple cell nuclei
(C) Surrounding cytoplasm
(D) Intracellular mitochondria

166. A male child inherits his X chromosome from which parent?
(A) Father
(B) Mother
(C) Both parents
(D) Neither

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into gametes, researchers can observe that the inheritance pattern of one trait does not influence or dictate the simultaneous inheritance pattern of another trait.

10. (C) Assertion (A) is true but Reason (R) is false.
Chromosomes are indeed specialized structures residing within the cell nucleus of eukaryotic organisms. However, chromosomes are composed of both deoxyribonucleic acid and specialized packaging proteins called histones, rather than being made entirely of proteins without nucleic acids. Therefore, the statement regarding chromosomal physical presence inside the nucleus is accurate, whereas the statement claiming an absence of nucleic acids is false.

11. (D) DNA
Deoxyribonucleic acid serves as the primary molecule storing and transmitting hereditary information in almost all living organisms. Its famous double-helix structure consists of two complementary polynucleotide chains wrapped around a central axis, stabilized by hydrogen bonding between nitrogenous base pairs. This molecular configuration enables accurate genetic replication and protein synthesis instruction coding across cellular divisions.

12. (A) A specific segment of DNA that controls a trait
A gene is structurally defined as a specific functional sequence of nucleotides along a DNA molecule. It contains the hereditary coding instructions required to synthesize operational functional proteins or functional RNA molecules, thereby determining specific biological traits, physiological characteristics, and biochemical activities within an organism throughout its lifecycle and across cellular generations.

13. (B) XY
Human biological sex is determined by the combination of sex chromosomes inherited at fertilization. Females possess two X chromosomes, whereas males inherit one X chromosome from the mother and one Y chromosome from the father. The presence of the Y chromosome triggers male embryonic development, ensuring that an XY genomic pairing results in male offspring.

14. (B) Sex-linked recessive inheritance
Haemophilia and color blindness represent classic conditions governed by sex-linked recessive inheritance. The mutated genes responsible for these conditions reside on the X chromosome. Because human males possess only a single X chromosome, inheriting one mutated allele causes full expression of the disorder, whereas females require two mutated copies on both X chromosomes to show symptoms.

15. (C) Gene → DNA → Chromosome → Nucleus
Organizing genetic material by structural hierarchy reveals that a gene is a small functional segment along a larger strand of deoxyribonucleic acid. DNA molecules wrap around histone proteins to condense into large nuclear structures known as chromosomes. These compact chromosomes reside inside the protective membrane-bound organelle known as the cell nucleus within eukaryotic organisms.

16. (C) Mutation
A mutation is defined as a sudden, permanent, and inheritable alteration in the base sequence of cellular DNA. These genomic changes can occur spontaneously during replication errors or be induced by environmental mutagens. Mutations generate new genetic variations within a population, serving as the ultimate primary source of diverse alleles necessary for evolutionary processes.

17. (D) It provides the raw material for adaptation to changing environments.
Genetic diversity is vital for species survival because it provides a broad pool of phenotypic variations within a population. When environmental conditions change, such as habitat alteration, disease emergence, or climate shifts, diverse genetic traits increase the likelihood that certain individuals possess characteristics allowing them to survive, reproduce, and prevent total population extinction.

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18. (C) Multiple alleles
Human ABO blood groups demonstrate multiple alleles because a single gene locus features three distinct allelic variants, designated as IA, IB, and i. Although any individual diploid human inherits only two of these alleles, the presence of three distinct alleles across the population enables complex inheritance patterns, including

180. Match the terms in List I with their appropriate examples in List II.

List I:
P. Inherited trait
Q. Acquired trait
R. Genetic disorder
S. Sex chromosome

List II:
1. X and Y
2. Haemophilia
3. Eye colour
4. Muscular build from lifting weights

(A) P-3, Q-4, R-2, S-1
(B) P-4, Q-3, R-1, S-2
(C) P-3, Q-4, R-1, S-2
(D) P-2, Q-4, R-3, S-1

181. In human sex determination, which parent determines the sex of the offspring?
(A) The mother, by contributing an X chromosome
(B) The father, by contributing either an X or a Y chromosome
(C) The mother, by contributing either an X or a Y chromosome
(D) Both parents equally

182. Why are purebred pea plants necessary for Mendel's initial cross (P generation)?
(A) They ensure that all the genetic traits being studied are completely heterozygous in nature.
(B) They ensure traits are homozygous and breed true when self-pollinated.
(C) They are the only specific pea plant varieties that are physically capable of being cross-pollinated.
(D) They consistently grow significantly faster and larger than any hybrid pea plant varieties.

183. Which term refers to the entire set of genes present in an organism?
(A) Phenotype
(B) Karyotype
(C) Proteome
(D) Genome

184. The application of genetic knowledge to produce improved cattle breeds with higher milk yield is an example of what?
(A) Environmental natural selection
(B) Selective breeding
(C) Random population genetic drift
(D) Spontaneous genetic mutation

185. A couple goes for genetic counselling because they both have a family history of a recessive genetic disorder. They are both carriers (heterozygous). What is the chance their child will have the disorder?
(A) 25%
(B) 50%
(C) 75%
(D) 100%

186. Which of the following is NOT a characteristic of homologous organs?
(A) Highly similar basic underlying anatomical structure
(B) Derived from a similar early embryonic development origin
(C) Similar function in all species
(D) Direct evidence indicating shared common evolutionary ancestry

187. The occurrence of a wide range of different alleles within a population is known as:
(A) Genetic engineering
(B) Genetic drift
(C) Natural selection
(D) Genetic diversity

188. Which of the following represents the genotype for a person with Down syndrome?
(A) Chromosomal status 45, XO
(B) Chromosomal status 47, XXY
(C) 47, +21
(D) Chromosomal status 46, XY

189. A trait that masks or hides the presence of another trait is called:
(A) Recessive
(B) Dominant
(C) Co-dominant
(D) Lethal

190. Consider the following statements about speciation:
I. It occurs when a population becomes reproductively isolated.
II. It requires accumulation of genetic differences over time.
III. It results in a group of organisms that can interbreed successfully.

Which of the above statement(s) is/are correct?
(A) I and II
(B) II and III
(C) I and III

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governed by genetic factors transmitted from parents to offspring. In contrast, traits such as language ability, muscular strength gained through exercise, or physical scars result entirely from environmental influences, personal learning, or injuries, making them non-inherited acquired traits.

29. (D) To advise families regarding the risks of inherited disorders
Genetic counseling is a clinical healthcare service aimed at informing individuals and families about the probability, inheritance patterns, and medical management of genetic disorders. Counselors analyze family histories and genetic testing results to help individuals understand inheritance risks, evaluate reproductive options, and make informed medical and personal decisions regarding hereditary conditions.

30. (A) I and II
Gregor Mendel selected garden pea plants for his experiments because they exhibit clearly defined pairs of contrasting characters, such as plant height and seed texture, allowing easy tracking across generations. He systematically analyzed seven distinct traits. Human subjects were never utilized in his models due to long generation times and ethical impossibility of controlled breeding.

31. (A) Selective breeding
Selective breeding, also known as artificial selection, applies fundamental genetic principles in agriculture and animal husbandry to produce superior varieties. Human breeders intentionally cross individuals displaying desirable phenotypic traits, such as high crop yield, drought resistance, or enhanced nutritional content, ensuring that advantageous alleles are consistently passed to future crop generations.

32. (D) All tall
When a purebred tall pea plant with homozygous genotype TT is crossed with a purebred dwarf plant with genotype tt, every offspring in the first filial generation receives one T allele and one t allele, resulting in a heterozygous Tt genotype. Because tallness is completely dominant over dwarfness, all offspring display the tall phenotype.

33. (B) An alternative variant form of a gene
An allele represents an alternative functional variant or version of a specific gene located at a designated chromosomal position. Differences in nucleotide sequences between alleles give rise to variations in inherited traits. For example, a single gene controlling plant height may feature one allele promoting tall growth and another allele promoting dwarf growth.

34. (D) Tt x tt
A test cross between a heterozygous tall pea plant displaying genotype Tt and a homozygous dwarf plant displaying genotype tt produces offspring with an equal 1:1 phenotypic ratio. Half of the resulting offspring inherit the dominant allele, yielding a tall phenotype, while the remaining half receive two recessive alleles, expressing the dwarf phenotype.

35. (A) Analogous organs
Bird wings and bat wings serve as classic examples of analogous organs because they perform the identical functional task of powered flight despite arising from different structural and evolutionary origins. Bird wings consist of feathered forelimbs, whereas bat wings comprise skin membranes stretched across elongated fingers, reflecting convergent evolution under similar environmental pressures.

36. (C) Gene
A gene represents the fundamental physical and functional unit of heredity passed from parents to offspring across generations. Composed of DNA sequences, genes contain coded instructional information required to construct proteins and execute cellular activities. These molecular sequences directly dictate the inheritance, development, and physiological expression of specific biological traits in living organisms.

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37. (D) A male child
In human sex determination, female gametes universally contribute an X chromosome, while male gametes carry either an X or a Y chromosome. When a Y-bearing sperm fertilizes an egg, the resulting zygote possesses an XY sex chromosome combination. This specific chromosomal configuration initiates male sexual differentiation, leading to the birth of a male offspring.

ANSWERS

1. (D) Heredity
Heredity refers to the biological mechanism by which genetic traits, physical characteristics, and biological information are passed down from parents to their offspring through successive generations. This fundamental genetic process relies on the transmission of nuclear DNA during reproduction, ensuring evolutionary continuity, morphological similarity, functional inheritance, and species identity while allowing minor variations across individual organisms throughout population lineages.

2. (C) Pisum sativum
Gregor Mendel selected the garden pea plant, known scientifically as Pisum sativum, for his foundational inheritance experiments because it possesses distinct contrasting traits, has a short life cycle, produces large numbers of offspring, and allows controlled self-pollination as well as cross-pollination. These biological characteristics permitted accurate statistical analysis of inherited phenotypic patterns across sequential generations.

3. (B) Recessive trait
In Mendelian inheritance, a recessive trait remains phenotypic hidden or unexpressed in the first filial generation when present alongside a dominant allele. The underlying genetic allele for this hidden characteristic is masked in heterozygous conditions and requires two identical copies, forming a homozygous recessive genotype, to manifest physically in subsequent generations of offspring.

4. (D) Phenotype
Phenotype represents the total set of observable physical, structural, biochemical, and physiological characteristics displayed by an organism. It is produced by the complex interaction between the individual's underlying genetic constitution, known as its genotype, and environmental factors. Common phenotypic features include visible traits such as height, eye color, plant flower pigmentation, and metabolic functioning.

5. (A) Homozygous
An organism is described as homozygous for a given gene when it carries two identical alleles at a specific genomic locus on homologous chromosomes. These identical alleles can either be both dominant or both recessive. Purebred lines in genetic studies are homozygous, consistently producing gametes with identical alleles and passing uniform traits to offspring.

6. (C) 3:1
In a classic Mendelian monohybrid cross involving two heterozygous parents carrying one dominant and one recessive allele, the resulting second filial generation exhibits a standard 3:1 phenotypic ratio. Three-fourths of the offspring display the dominant physical characteristic, while one-fourth manifests the hidden recessive phenotype due to random segregation of alleles during gamete formation.

7. (A) 9:3:3:1
A Mendelian dihybrid cross tracking two independently assorting traits across heterozygous parents yields a distinct 9:3:3:1 phenotypic ratio in the second filial generation. This mathematical outcome represents nine individuals showing both dominant traits, three displaying the first dominant and second recessive trait, three exhibiting the first recessive and second dominant trait, and one showing both recessive traits.

8. (D) Law of Segregation
The Law of Segregation establishes that allele pairs separate during the formation of gametes in meiotic cell division. As a consequence of this fundamental principle, each mature gamete receives only one allele for any given inherited trait. Upon fertilization, the fusion of male and female gametes restores the diploid condition in the resulting offspring zygote.

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9. (B) Dihybrid cross
Mendel's Law of Independent Assortment is best demonstrated through a dihybrid cross, which concurrently tracks two distinct, non-linked genetic characteristics. By observing how pairs of alleles for different traits separate independently

(D) I, II, and III

191. Which molecule forms the rungs (steps) of the DNA double helix ladder?
(A) Alternating deoxyribose sugar molecules
(B) Structural outer phosphate backbone groups
(C) Nitrogenous base pairs
(D) Associated histone protein structural complexes

192. A cross that involves studying the inheritance of a single trait is termed a:
(A) Monohybrid cross
(B) Dihybrid cross
(C) Trihybrid cross
(D) Polyhybrid cross

193. Which of the following correctly pairs an evolutionary concept with its corresponding evidence?
(A) Fossil remains - Molecular biochemical evolutionary evidence
(B) Homologous organs - Morphological evidence
(C) Comparative DNA sequencing - Anatomical vestigial evidence
(D) Comparative embryology - Spatial biogeographical evidence

194. Why is the study of fossils vital for understanding evolution?
(A) Fossils provide a completely continuous, unbroken physical record of all life forms on Earth.
(B) Fossils show structural transitions between extinct and modern species.
(C) Fossils provide clear scientific evidence proving that biological species never undergo evolutionary change.
(D) Fossils naturally contain preserved living DNA strands that can be directly used for modern genetic engineering.

195. Consider the following statements regarding genetic mutations:
I. Mutations are always harmful to an organism.
II. Mutations can create new alleles.
III. Mutations occur as sudden changes in the DNA sequence.
IV. Beneficial mutations can drive evolutionary change.
Which of the above statement(s) is/are correct?
(A) I, II, and III
(B) II, III, and IV
(C) I, III, and IV
(D) I, II, and IV

196. The genetic combination 'XY' dictates which sex in humans?
(A) Female
(B) Male
(C) Hermaphrodite
(D) Undifferentiated

197. What causes the traits of an organism to be expressed as its phenotype?
(A) Its genotype alone, completely unaffected by the environment
(B) The environment alone, ignoring the genetic makeup
(C) Random chance during embryonic development
(D) The interaction between its genotype and the environment

198. Which of the following is the best example of genetic engineering in medicine?
(A) Administering traditional herbal remedies and plant extracts for common viral colds
(B) Safely performing a routine clinical whole blood transfusion in a hospital setting
(C) Mass production of insulin using modified bacteria
(D) Surgically aligning and setting a broken skeletal bone within a plaster cast

199. Mendel's Law of Segregation is directly related to which cellular process?
(A) The exact biochemical replication of DNA strands in the nucleus
(B) Chromosomal separation during meiosis
(C) The physical fusion and joining of egg and sperm cells during fertilisation
(D) The translation process and building of functional proteins by cytoplasmic ribosomes

200. What is the fundamental difference between inherited traits and acquired traits?
(A) Inherited traits are recorded in DNA, while acquired traits are not.
(B) Inherited traits occur only in animals, while acquired traits occur only in plants.
(C) Inherited traits are caused by the environment, while acquired traits are genetic.
(D) Inherited traits disappear in one generation, while acquired traits persist.

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complete dominance, recessiveness, and codominance.

19. (B) Autosomal chromosome 21
Down syndrome is a human chromosomal condition resulting from an abnormality in autosomal chromosome 21, specifically the presence of an extra copy of this non-sex chromosome. Known medically as trisomy 21, this genomic imbalance alters normal embryonic development, leading to characteristic physical features, developmental delays, and distinct health challenges throughout the individual's life.

20. (A) P-3, Q-2, R-4, S-1
Genotype represents the specific internal genetic constitution of an organism, while phenotype refers to its external observable characteristics. An individual carrying two identical alleles for a particular gene is classified as homozygous, whereas an individual possessing two different alleles for that gene is classified as heterozygous. Matching these definitions yields the correct conceptual pairings.

21. (D) Speciation
Speciation is the evolutionary mechanism through which distinct new biological species arise from pre-existing ancestral populations. This process typically occurs when geographic, behavioral, or ecological barriers isolate populations, preventing gene flow. Over time, independent evolutionary forces, accumulated mutations, and genetic drift cause populations to diverge until reproductive isolation occurs.

22. (A) Charles Darwin
Charles Darwin formulated the comprehensive theory of evolution through natural selection, publishing his groundbreaking findings in his work on species origin. He demonstrated that organisms with traits better suited to their environment enjoy higher survival and reproductive success. These advantageous traits gradually become more widespread within successive generations, leading to evolutionary change.

23. (D) Survival of the fittest
The concept of survival of the fittest forms the core mechanism of Darwinian natural selection. It dictates that individuals possessing beneficial phenotypic adaptations are better equipped to survive competitive environmental pressures, secure resources, and reproduce successfully. Consequently, their advantageous traits are transmitted at higher frequencies to subsequent generations, driving species adaptation.

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24. (B) Homologous organs
Homologous organs are anatomical structures found in different species that share a common ancestral origin and similar basic structural layout, despite performing distinct functions adapted to diverse ecological niches. A classic example includes the forelimbs of humans, bats, and whales, which possess matching skeletal frameworks modified for grasping, flying, and swimming respectively.

25. (A) III, IV, I, II
Speciation follows a logical sequence beginning with geographical isolation dividing a population into separate groups. Subsequently, independent genetic variations accumulate in each isolated group over time. Natural selection acts differently on these distinct populations based on local environmental pressures. Finally, reproductive isolation establishes full speciation, preventing interbreeding even if physical contact resumes.

26. (A) Fossils
Fossils represent the preserved physical remains, traces, or imprints of ancient organisms preserved within geological formations like sedimentary rock layers. They offer invaluable direct evidence of past life forms, structural adaptations, and evolutionary transitions over Earth's history, enabling paleontologists to reconstruct ancestral lineages and understand how historical organisms interacted with changing global environments.

27. (D) Applied genetic engineering
Genetic engineering is an applied biological discipline involving direct laboratory manipulation, modification, or recombinant editing of an organism's genomic material. By altering DNA sequences or inserting foreign genes, scientists can impart novel beneficial traits, produce commercial pharmaceuticals like human insulin, develop pest-resistant agricultural crops, and pioneer targeted therapeutic strategies for treating genetic conditions.

28. (C) Attached or free earlobes
Attached or free earlobes represent a classic, simple inherited physical trait in humans

48. (C) Alleles of different traits assort independently during gamete formation.
Mendel's Law of Independent Assortment establishes that alleles controlling different, unlinked physical traits separate into gametes completely independently of one another during meiotic cell division. Consequently, the inheritance of an allele for one trait, such as seed shape, does not influence or dictate the simultaneous inheritance of an allele for an unrelated trait.

49. (B) Homologous structures
The forelimbs of humans, dogs, and whales represent homologous structures because they share a fundamental underlying skeletal anatomy derived from a common mammalian ancestor. Although modified through evolutionary adaptation to perform distinct functions such as grasping, running, or swimming, their shared bone arrangement provides strong morphological evidence of divergent evolutionary development.

50. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
In humans, sex determination is dictated by the father's gametes. Human females carry two X chromosomes, producing eggs containing only X chromosomes. Human males possess one X and one Y chromosome, producing sperm cells carrying either an X or Y chromosome. Fertilization by an X-bearing or Y-bearing sperm determines female or male offspring sex.

51. (A) Agricultural genetics
Agricultural genetics applies fundamental principles of heredity, molecular biology, and selective breeding to crop production and livestock management. By identifying and combining advantageous alleles, agricultural geneticists develop improved plant varieties that demonstrate enhanced crop yield, superior nutritional profiles, increased drought tolerance, and strong resistance against destructive bacterial, fungal, or insect agricultural pests.

52. (D) A sudden and permanent change in the genetic material
A mutation is best defined as a sudden, structural, and permanent alteration in the genomic sequence of an organism's DNA. Occurring spontaneously or induced by environmental radiation and chemicals, mutations alter base pairs or chromosome structures. They generate novel alleles, introducing genetic variation necessary for biological evolution and natural selection processes.

53. (B) AB
An individual possessing the blood group genotype IA IB expresses blood group AB due to codominance between the two alleles. Both the IA allele and IB allele are fully expressed on the surface of red blood cells, producing both A and B antigens simultaneously without blending or masking each other's phenotypic expression.

54. (D) Dominant
When crossing a pure tall plant with a pure dwarf plant yields offspring that are all tall, tallness is demonstrated to be a dominant trait. The dominant allele completely masks the expression of the recessive dwarf allele in the heterozygous condition, ensuring that only the tall phenotype is physically expressed in offspring.

55. (A) Having two recessive alleles for a trait
The term homozygous recessive describes a genetic condition in which an organism inherits two identical copies of a recessive allele for a specific trait. Because no dominant allele is present to mask it, the recessive phenotype is fully expressed physically in the organism's observable features across its lifecycle.

56. (D) It states acquired traits are passed to offspring.
Charles Darwin's evolutionary theory centers on natural selection, differential reproductive success, and adaptation over time. However, Darwin did not propose that acquired characteristics developed during an individual's lifetime are inherited by offspring. The inheritance of acquired traits was advocated by Jean-Baptiste Lamarck and was later disproven by modern genetics principles.

57. (C) Speciation
Speciation refers to the evolutionary mechanism by which pre-existing biological populations evolve to become distinct, reproductively isolated species. Driven by factors such as geographical separation, genetic drift, natural selection, and mutation accumulation, speciation prevents gene flow between groups, leading to the formation of independent lineages adapted to different ecological niches.

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38. (A) X chromosome only
Human females possess two X sex chromosomes in their somatic diploid cells. During the process of meiosis, these chromosomes segregate into single gametes, ensuring that every normal female egg cell carries exactly one X chromosome. Consequently, human eggs are entirely homogeneous regarding sex chromosome type, whereas male sperm cells carry either an X or a Y chromosome.

39. (D) Acquired knowledge of mathematics
Knowledge of mathematics is an acquired characteristic developed through education, study, and mental practice during an individual's lifetime. Such acquired traits alter somatic brain connections without altering the genomic sequence of germline cells. Consequently, non-genetic accomplishments cannot be passed down to offspring, unlike inherited biological traits like eye color, hair type, or blood group.

40. (B) I, II, and IV
Deoxyribonucleic acid is the primary genetic material residing mainly within eukaryotic cell nuclei, responsible for encoding instructions needed for protein synthesis. However, DNA naturally exists as a double-stranded helical structure bound by hydrogen bonds between complementary base pairs, rather than as a single-stranded spiral. Thus, statements regarding its name, location, and function are accurate.

41. (C) Fossil evidence
Fossil evidence provides direct paleontological proof of past life by analyzing preserved remains, mineralized bones, or structural traces locked within distinct geological rock strata. Studying deeper sedimentary layers allows scientists to establish chronological timelines, document structural modifications, identify transitional organisms, and reconstruct evolutionary history across millions of years of Earth's biological existence.

42. (D) Law of Dominance
Mendel's Law of Dominance states that in a heterozygous individual carrying two contrasting alleles for a specific trait, one allele completely masks the expression of the other. The expressed allele is designated as dominant, determining the physical phenotype, while the masked allele remains recessive and unexpressed unless paired with another identical recessive allele.

43. (A) Red-green colour blindness
Red-green color blindness is a classic sex-linked recessive genetic disorder caused by mutations in photoreceptor genes located on the human X chromosome. Because males possess only one X chromosome, inheriting a single mutated allele results in full visual impairment, whereas females require two mutated X chromosomes to express this recessive vision impairment phenotype physically.

44. (D) DNA and proteins
Chromosomes are complex nuclear structures composed fundamentally of deoxyribonucleic acid tightly packaged with specialized structural proteins called histones. This DNA-protein complex, known as chromatin, allows long genomic strands to condense efficiently inside the nucleus. This organization protects genetic material, regulates gene expression, and ensures accurate segregation during cellular division processes like mitosis.

45. (A) Trisomy 21
Down syndrome is clinically designated as Trisomy 21 because it is caused by the presence of a third copy of autosomal chromosome 21. This chromosomal abnormality arises primarily from non-disjunction during meiotic gamete division, leading to an altered overall chromosome count of 47 and causing characteristic physical, cognitive, and physiological developmental variations.

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46. (C) Phenotype
Phenotype encompasses all observable physical traits, biochemical properties, and behavioral traits displayed by a living organism. It is determined by the complex dynamic interaction between the organism's inherited genetic constitution, known as its genotype, and surrounding environmental influences like nutrition, climate, and sunlight exposure experienced throughout its life cycle.

47. (D) Natural selection
Natural selection is the evolutionary process wherein organisms possessing advantageous heritable variations are better adapted to survive, compete for resources, and reproduce within their environment. Over successive generations, these favorable traits increase in frequency within the population, while less beneficial variations decrease, driving gradual adaptation and speciation across changing ecological niches.

167. Which of the following defines 'speciation'?
(A) The overall physical growth and development of an individual organism
(B) Formation of a new species from an existing one
(C) The gradual environmental destruction of a natural species habitat
(D) The complete extinction and death of an entire biological species

168. Which of the following features is considered a vestigial organ in humans?
(A) Human liver
(B) Human lungs
(C) Appendix
(D) Human spleen

169. What type of cross did Mendel perform to deduce the Law of Independent Assortment?
(A) Monohybrid cross
(B) Test cross
(C) Reciprocal cross
(D) Dihybrid cross

170. Given below are two statements, one labelled as Assertion (A) and the other as Reason (R).
Assertion (A): The F_2 generation of a monohybrid cross always shows a 3:1 phenotypic ratio for Mendelian traits.
Reason (R): The recessive trait is completely lost in the F_1 generation and cannot reappear.
(A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
(B) Both Assertion (A) and Reason (R) are true but R is not the correct explanation of A.
(C) Assertion (A) is true but Reason (R) is false.
(D) Assertion (A) is false but Reason (R) is true.

171. If a fossil is found deep in the Earth's sedimentary layers, what can generally be concluded?
(A) It is older than fossils found in shallower layers.
(B) It is younger than fossils found in shallower layers.
(C) It is from the same time period as all other fossils.
(D) It belongs to a currently living species.

172. Genetic engineering fundamentally involves the artificial manipulation of which of the following?
(A) Proteins
(B) Genes
(C) Carbohydrates
(D) Lipids

173. What is the observable result of the genotype 'IA IB' in a human?
(A) Phenotypic blood group A
(B) Phenotypic blood group B
(C) Phenotypic blood group O
(D) Blood group AB

174. Which process allows the combination of genetic material from two different parents?
(A) Sexual reproduction
(B) Mitosis
(C) Asexual reproduction
(D) Binary fission

175. Arrange the following steps of natural selection in the correct order:
I. Overproduction of offspring
II. Survival of the fittest
III. Inherited variation exists within a population
IV. Favorable traits are passed to the next generation
(A) III, I, II, IV
(B) I, III, II, IV
(C) III, II, I, IV
(D) I, II, III, IV

176. Which condition is a primary focus of genetic counselling due to its hereditary nature?
(A) Bacterial typhoid fever
(B) Colour blindness
(C) Acute bacterial cholera
(D) Mosquito-transmitted malaria

177. The term 'Survival of the Fittest' was coined by Herbert Spencer, but it is heavily associated with the theory of which scientist?
(A) Gregor Mendel
(B) Charles Darwin
(C) Louis Pasteur
(D) Rosalind Franklin

178. What is the phenotypic ratio of a Mendelian dihybrid cross?
(A) 3:1
(B) 1:2:1
(C) 9:3:3:1
(D) 1:1:1:1

179. A permanent change in the nucleotide sequence of DNA is termed:
(A) Translation
(B) Transcription
(C) Mutation
(D) Replication

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58. (C) Inherited disorders
Genetic counseling specializes in evaluating personal and medical family histories to assess the risk of inherited disorders. Counselors educate individuals and parents about chromosomal abnormalities, single-gene inherited conditions, recurrence probabilities, and testing options, helping them make informed reproductive choices rather than focusing on non-inherited infectious diseases or nutritional deficiencies.

59. (C) Gregor Mendel
Gregor Mendel is universally acknowledged as the Father of Genetics for his pioneering mid-nineteenth-century experiments on garden pea plants. By meticulously tracking phenotypic inheritance patterns, he deduced fundamental laws governing gene segregation and independent assortment, establishing the quantitative mathematical foundation for modern genetics long before the molecular structure of DNA was discovered.

60. (A) P-3, Q-2, R-1, S-4
Pea plants were utilized by Gregor Mendel to deduce fundamental inheritance laws. Human blood types illustrate multiple allelism with three distinct alleles governing ABO groups. Galapagos finches were observed by Charles Darwin as evidence for evolution by natural selection. Bacteria serve as core tool organisms extensively used in applied genetic engineering techniques.

61. (B) Haemophilia
Haemophilia is a hereditary genetic disorder characterized by impaired blood coagulation, leading to prolonged bleeding from minor injuries. Caused by recessive mutations in clotting factor genes located on the X chromosome, haemophilia primarily affects males who inherit a single mutated copy, while females require two mutated X chromosomes to display the medical condition.

62. (D) Bird wing and insect wing
Bird wings and insect wings constitute an analogous organ pair because both structures are adapted for aerial flight but possess fundamentally different structural arrangements and anatomical origins. Bird wings contain a skeletal endoskeleton covered with feathers, while insect wings consist of chitinous cuticular membranes, illustrating convergent evolution under similar selection pressures.

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63. (C) Nucleus
The nucleus is the membrane-bound organelle inside eukaryotic cells that houses the genetic material organized as thread-like chromosomes. Composed of tightly packed DNA strands and histone proteins, these nuclear structures contain all inherited instructions necessary for cellular regulation, enzyme production, growth, repair, and transmission of biological traits to subsequent daughter cells.

64. (D) Dominant
A genetic trait is defined as dominant when it is expressed physically in both homozygous dominant and heterozygous conditions. The presence of a single dominant allele is sufficient to determine the organism's observable phenotypic characteristic, completely masking the physical expression of any contrasting recessive allele present at the same locus.

65. (A) Homozygous recessive
The genetic constitution yy in a pea plant represents a homozygous recessive genotype because it contains two identical recessive alleles for seed color. In Mendelian genetics, uppercase letters denote dominant alleles while lowercase letters represent recessive alleles. Thus, possessing two matching lowercase alleles signifies a purebred recessive genetic condition expressing green seeds.

66. (B) Genetics
Genetics is the specialized branch of biological science dedicated to studying heredity, gene function, and variation across living organisms. It investigates how genetic information is encoded in DNA, transmitted from parents to offspring, expressed as physical traits, and modified through mutations or environmental interactions over short generational periods and long evolutionary timelines.

67. (B) 1:2:1
In the F_2 generation of a classic Mendelian monohybrid cross between two heterozygous parents, the genotypic ratio is 1:2:1. This mathematical proportion corresponds to one homozygous dominant individual, two heterozygous dominant individuals, and one homozygous recessive individual, reflecting the underlying random segregation and combination of parental gametic alleles during fertilization.

including factors such as temperature, nutrition, and sunlight.

89. (B) HMS Beagle
Charles Darwin embarked on his historic five-year voyage aboard the survey ship HMS Beagle. During this journey, particularly while surveying the Galapagos Islands, Darwin collected extensive geological, botanical, and zoological specimens. His key observations of species adaptations directly informed his development of the theory of evolution by natural selection.

90. (D) Assertion (A) is false but Reason (R) is true.
Analogous organs perform similar functions in different species but do not indicate common evolutionary ancestry. Instead, they arise independently through convergent evolution in response to similar environmental demands. Consequently, while the statement that analogous organs reflect common ancestry is true as an abstract definition of homologous traits, it is false regarding analogous structures.

91. (B) Watson and Crick
James Watson and Francis Crick famously deduced the double-helix molecular structure of DNA in 1953, utilizing X-ray diffraction data gathered by Rosalind Franklin and Maurice Wilkins. Their revolutionary double-stranded model explained how genetic information is chemically encoded, replicated accurately during cell division, and passed intact across biological generations.

92. (D) Blue eyes
Blue eyes represent a classic recessive genetic trait in human ocular pigmentation inheritance. Expressing blue eye phenotype generally requires an individual to inherit two copies of the recessive allele, forming a homozygous recessive genotype. In contrast, traits like brown eye color, free earlobes, and naturally curly hair are typically governed by dominant alleles.

93. (B) Mutation
A sudden change in the physical structure or overall number of chromosomes within a cell is classified as a chromosomal mutation. Caused by non-disjunction, deletions, duplications, or translocations during cellular division, these large-scale genomic alterations modify gene dosage and structure, often resulting in significant phenotypic changes or developmental disorders.

94. (D) Charles Darwin
Charles Darwin authored the landmark scientific book "On the Origin of Species," published in 1859. The work detailed his extensive empirical evidence supporting biological evolution and introduced natural selection as the primary driving mechanism behind species adaptation, diversification, and the emergence of new biological forms over geological time.

95. (A) Selective breeding
Modern agricultural crop varieties have been systematically developed through selective breeding, also called artificial selection. Farmers and agricultural scientists intentionally select and cross individual plants displaying superior traits, such as larger fruit, higher yield, or pest resistance, gradually enhancing these desirable characteristics across successive plant generations over thousands of years.

96. (B) Homozygous recessive
An organism carrying two matching copies of a recessive allele for a specific trait is described as homozygous recessive. Because no dominant allele is present to mask its expression, the recessive phenotype is physically expressed in the individual's observable features, representing a true-breeding line for that specific genetic characteristic.

97. (D) Natural selection
Natural selection is the evolutionary process whereby organisms carrying advantageous heritable traits survive and reproduce more successfully than others. Over generations, these beneficial variations increase in frequency within the population's gene pool, enhancing overall environmental adaptation and driving gradual evolutionary changes across species lineages.

98. (C) Hereditary diseases
Genetic counseling is primarily designed for families with histories of hereditary diseases, such as cystic fibrosis, sickle cell anemia, or haemophilia. Healthcare professionals evaluate genetic risks, explain inheritance patterns, offer DNA testing options, and assist families in making informed reproductive and medical decisions, rather than addressing infectious or nutritional conditions.

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activities such as learning languages, riding bicycles, or building muscle through exercise are acquired behaviors and physical changes resulting from practice, training, and environmental experiences, which cannot be inherited genetically.

79. (B) Dihybrid cross
The Law of Independent Assortment applies specifically to crosses involving two or more unlinked traits, such as a dihybrid cross. It demonstrates that alleles for distinct genes separate independently into gametes during meiotic division, a phenomenon that cannot be observed when examining a single trait in a standard monohybrid cross.

80. (A) I and II
Down syndrome is a human chromosomal disorder resulting from trisomy 21, where cells contain an extra copy of autosomal chromosome 21. It affects both males and females equally and arises from non-disjunction during gamete formation. It is not caused by bacterial infections, viral pathogens, or environmental pregnancy complications.

81. (B) 50%
The probability of conceiving a boy in any given pregnancy remains strictly 50%, regardless of the sex of previous children. Each fertilization event is an independent outcome determined by whether an X-bearing or Y-bearing sperm fertilizes the egg, maintaining an equal statistical chance for male or female offspring every time.

82. (D) Incubation temperature
In certain reptile species, such as crocodiles and sea turtles, sex determination is dictated by incubation temperature during critical periods of embryonic development inside the nest. Extreme warm or cool nest temperatures trigger hormonal pathways that bias offspring development toward male or female sexes, representing environmentally driven sex determination.

83. (B) Variation
Variation describes the observable differences in physical, physiological, or genetic characteristics among individual organisms belonging to the same biological species. Arising from genetic mutations, meiotic crossing over, and environmental influences, variation provides the diversity required for populations to adapt to ecological shifts and serves as the raw material for natural selection.

84. (D) Fossils
Fossils supply direct physical evidence documenting structural transitions and evolutionary changes in species over vast geological periods. Preserved in sedimentary rock formations, these mineralized remains, imprints, and traces enable paleontologists to compare ancient anatomical features with modern organisms, establishing evolutionary relationships and tracking lineage modifications across history.

85. (B) Producer → Herbivore → Carnivore → Decomposer
A terrestrial food chain follows an ordered sequence of energy transfer across trophic levels. Photosynthetic producers capture solar energy to manufacture organic matter. Primary consumers, or herbivores, eat producers to obtain energy. Secondary consumers, or carnivores, prey upon herbivores. Finally, decomposers break down dead organic matter, recycling nutrients into the ecosystem.

86. (A) One
A normal human gamete, whether a sperm or an egg, carries exactly one allele for any given gene trait. This haploid condition results from meiotic cell division, during which homologous chromosome pairs separate. Upon fertilization, two haploid gametes fuse, restoring the diploid state with two alleles per trait in the zygote.

87. (D) Hybrid tall
A pea plant possessing the genotype Tt for height is classified as a hybrid tall individual. The term hybrid indicates a heterozygous condition containing two different alleles for the trait, while tall represents the expressed phenotype because the dominant tall allele T completely masks the presence of the recessive dwarf allele t.

88. (D) Phenotype
Phenotype encompasses all manifest physical features, anatomical traits, physiological attributes, and behavioral patterns shown by an organism. It results from the dynamic interaction between the organism's genetic makeup, known as its genotype, and surrounding environmental conditions experienced throughout its lifespan,

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genotype tt are pure lines because they contain identical pairs of alleles, ensuring consistent phenotypic expression and uniform inheritance when self-pollinated over successive generations.

110. (B) I and III
Speciation occurs when geographical barriers isolate populations, halting gene flow and promoting reproductive isolation over time. Genetic drift and natural selection cause independent variations to accumulate in isolated groups. Speciation describes the emergence of new biological species, whereas extinction refers to the complete permanent loss of a species.

111. (D) O
In basic human ABO blood genetics, type O negative blood is recognized as the universal donor choice. Red blood cells from individuals with blood group O lack both A and B surface antigens, preventing immune system recognition and rejection reactions when transfused into recipients possessing different ABO blood groups.

112. (A) They evolved from a common ancestor.
The structural similarities observed between a human arm and a bird wing signify that these forelimbs are homologous structures derived from a common tetrapod ancestor. Despite serving different modern functional adaptations such as manipulation and flight, their identical skeletal arrangement provides clear morphological evidence of shared evolutionary lineage.

113. (A) Survive and reproduce
In Darwinian evolutionary biology, an organism's biological fitness is measured by its capacity to survive environmental challenges and successfully reproduce viable offspring. Individuals possessing advantageous adaptations contribute a higher proportion of their genes to future generations, increasing the prevalence of their beneficial phenotypic traits within the population's gene pool.

114. (B) Because the gene has three alleles: IA, IB, and i.
ABO blood group inheritance illustrates multiple allelism because the gene controlling red blood cell surface antigens features three distinct allelic variants: IA, IB, and i. While an individual carries only two alleles, the presence of three alleles across the broader human population allows diverse blood group phenotypes and genotypes.

115. (C) All offspring are tall.
Crossing a homozygous dominant parent with genotype TT and a heterozygous parent with genotype Tt yields offspring with genotypes TT and Tt in equal proportions. Because every offspring receives at least one dominant T allele, the dominant tall phenotype is fully expressed in 100% of the resulting generation.

116. (B) Haemophilia - Sex-linked recessive
Haemophilia is correctly paired as a sex-linked recessive genetic disorder caused by mutated genes on the X chromosome. Affected individuals experience defective blood clotting. Males are primarily affected due to possessing a single X chromosome, whereas females require two mutated X alleles to express this recessive blood coagulation condition.

117. (B) Autosome
An autosome is any chromosome that is not classified as a sex chromosome. In human diploid somatic cells, 22 of the 23 pairs are autosomes, carrying genes that regulate general somatic development, physiological functions, and metabolic processes, while remaining identical in number and structure across both male and female sexes.

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118. (D) A scar on the face
A scar on the face is an acquired trait resulting from physical injury, tissue damage, and subsequent somatic cellular repair during an individual's lifetime. Because physical scarring does not alter genomic sequences in germline reproductive cells, it cannot be passed down to offspring, unlike inherited traits like blood type or eye color.

119. (B) Nucleotide
A nucleotide serves as the fundamental monomeric building block constructing DNA and RNA nucleic acid chains. Each individual nucleotide consists of three chemical parts: a nitrogenous base, a five-carbon deoxyribose sugar molecule, and a phosphate group. Linked together sequentially, nucleotides form the double-stranded genetic code that stores cellular instructional information.

99. (B) 44 autosomes + XY
A normal human male somatic cell possesses a complete diploid complement of 46 chromosomes. This chromosomal arrangement comprises 44 autosomes, arranged as 22 matching pairs regulating non-sex biological traits, along with one pair of sex chromosomes consisting of one X chromosome and one Y chromosome, which dictates male sex development.

100. (A) P-1, Q-2, R-3, S-4
In Mendelian genetics of garden pea plants, tall stem growth is dominant over dwarf stem growth, which represents a recessive trait. Similarly, round seed shape acts as a dominant characteristic over wrinkled seed shape, which is recessive. Matching these classical contrasting traits aligns correctly with their established dominance and recessiveness statuses.

101. (D) Meiosis and fertilisation
The combination of meiosis and fertilization ensures chromosome number stability across generations. Meiosis reduces the diploid chromosome count by half to produce haploid gametes containing one chromosome set. Upon fertilization, the fusion of two haploid gametes restores the complete diploid chromosome number in the resulting offspring zygote.

102. (B) Factors
Before the term gene was coined in modern genetics, Gregor Mendel described the fundamental units of inheritance as particulate factors. He postulated that these discrete biological factors were passed unchanged from parents to offspring through gametes, operating in pairs to control specific contrasting physical characteristics across successive plant generations.

103. (D) Female
Biological sex in humans is determined by the combination of inherited sex chromosomes. An egg cell always provides an X chromosome, while a sperm cell contributes either an X or a Y chromosome. Inheriting an X chromosome from both father and mother produces an XX genotype, which initiates female biological development.

104. (C) Selective breeding of domestic dogs
Selective breeding of domestic dogs relies on traditional artificial selection through controlled mating of animals with desired phenotypic traits without directly altering DNA at the molecular level. In contrast, applications such as pest-resistant crops, insulin synthesis by recombinant bacteria, and oil-spill cleanup microbes directly involve laboratory-based genetic engineering techniques.

105. (A) II, I, III, IV
Mendel's experimental methodology followed a precise sequential order. First, he selected purebred true-breeding pea plants for contrasting traits. Next, he cross-pollinated these parent plants to generate the F_1 generation. He then allowed F_1 plants to self-pollinate, and finally observed and mathematically analyzed phenotypic ratios within the F_2 generation offspring.

106. (B) Their wings are analogous structures.
Bird wings and bat wings provide evidence that these species do not share a recent common ancestor for their flight structures because their wings are analogous structures. While both enable powered flight, bird wings feature feathers over forelimbs, whereas bat wings consist of skin stretched across digits, illustrating convergent evolution.

107. (B) Meiosis
Meiosis is the specialized form of cellular division responsible for producing reproductive gametes, such as sperm and egg cells. Through two consecutive nuclear divisions accompanied by one round of DNA replication, meiosis reduces the original diploid chromosome number by half, yielding four haploid gametes possessing unique genetic recombinations.

108. (C) Law of Independent Assortment
The 9:3:3:1 phenotypic ratio observed in the second filial generation of a Mendelian dihybrid cross is the hallmark outcome of the Law of Independent Assortment. It proves that during meiotic gamete formation, alleles governing one specific trait segregate into gametes completely independently of alleles controlling an unrelated trait.

109. (B) TT and tt
Pure lines represent true-breeding genetic lineages that are homozygous for a given trait. Homozygous dominant plants carrying genotype TT and homozygous recessive plants carrying

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152. (C) They express genes to determine traits.
Proteins play a crucial physical and functional role in heredity by acting as the molecular tools that express genetic instructions encoded in DNA. Enzymes, structural proteins, and regulatory molecules synthesized from gene templates carry out metabolic activities and cell development, directly translating underlying genotypic codes into observable phenotypic traits.

153. (B) Round, yellow seeds
Crossing an RRyy plant producing round, green seeds with an rrYY plant producing wrinkled, yellow seeds yields all RrYy offspring in the F_1 generation. Because round seed shape (R) is dominant over wrinkled (r) and yellow seed color (Y) is dominant over green (y), all offspring produce round, yellow seeds.

154. (D) O
In ABO blood group inheritance, blood group O is expressed phenotypically only in a homozygous condition with genotype ii. The i allele is recessive to both dominant IA and IB alleles. Consequently, an individual must inherit two copies of the recessive i allele to express the blood group O phenotype.

155. (A) Nucleotide → Gene → DNA → Chromosome
Organizing genetic structures from smallest to largest starts with a single nucleotide monomer. Multiple linked nucleotides construct a gene sequence. Long continuous strands of genes and non-coding regions form a deoxyribonucleic acid molecule. Finally, a DNA molecule packages tightly with histone proteins into a large nuclear chromosome structure.

156. (B) Genetic counselling
Genetic counseling is the medical healthcare practice of advising individuals and families affected by or at risk of genetic disorders. Professional counselors evaluate medical family histories, interpret chromosomal and DNA diagnostic tests, explain inheritance patterns, and discuss reproductive risks and management options to guide informed personal and medical choices.

157. (B) Peppered moths
The peppered moth, known as Biston betularia, provides classical evidence of natural selection in response to industrial pollution, a phenomenon known as industrial melanism. Soot covering trees during the Industrial Revolution favored dark-colored moths over light-colored ones, as dark moths evaded predators, increasing dark allele frequencies within urban moth populations.

158. (C) 50%
A carrier mother with genotype XHXh passes either her normal XH chromosome or her mutated Xh chromosome to her sons with equal probability. Because the father contributes a Y chromosome to male offspring, there is a 50% chance that any son will inherit the Xh chromosome and express haemophilia phenotypically.

159. (D) Tongue rolling ability
Tongue rolling ability is a classic simple inherited physical trait in humans governed by genetic factors passed down from parents. In contrast, traits like body weight, hair length, and callus formation vary according to diet, personal grooming, physical exercise, and environmental factors, classifying them as non-inherited acquired characteristics.

160. (A) I, II, and III
Natural selection relies fundamentally on pre-existing genetic variation within a population. It systematically favors individuals possessing advantageous traits, allowing them to adapt to their local environment and pass beneficial alleles to offspring. Natural selection is a non-random directional process driven by differential reproductive success, making statement IV completely inaccurate.

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161. (C) Incomplete dominance
Crossing a red-flowered plant with a white-flowered plant to yield pink-flowered offspring clearly demonstrates incomplete dominance. In this non-Mendelian inheritance pattern, neither allele is completely dominant over the other, resulting in an intermediate blended phenotype in heterozygous individuals that combines characteristics of both homozygous red and white parental lines.

162. (D) It reduces the risk of total crop failure from a single disease.
Genetic diversity in agricultural crops reduces the vulnerability of entire harvests to a single disease or environmental stressor. When a population contains varied genetic traits, certain individual plants possess natural resistance mechanisms, ensuring that an emerging pathogen or drought

120. (A) I and II
Charles Darwin formulated the foundational theory of evolution by natural selection and conducted detailed observational studies of finches on the Galapagos Islands. However, he did not discover DNA structure, which was accomplished by Watson and Crick, nor did he coin the word gene, which was introduced later by Wilhelm Johannsen.

121. (D) Screen for genetic defects
Basic principles of heredity are broadly applied in modern medicine to screen for genetic defects, inherited metabolic disorders, and chromosomal abnormalities. Genetic screening techniques enable healthcare professionals to identify inherited risk factors early, offer prenatal diagnostic evaluations, and design targeted therapeutic management plans for individuals and prospective parents.

122. (C) Tt x Tt
Crossing two heterozygous individuals with genotype Tt clearly demonstrates the Law of Segregation. During gamete formation, the dominant allele T and recessive allele t separate randomly. Their random combination yields offspring with genotypes TT, Tt, and tt, allowing the masked recessive dwarf trait to reappear in the phenotype.

123. (A) One
A normal human gamete, whether a sperm or an egg cell, contains exactly one sex chromosome. Produced through meiotic reduction division, egg cells consistently carry a single X chromosome, whereas sperm cells carry either one X or one Y chromosome. Fusion during fertilization restores the diploid pair of sex chromosomes.

124. (D) Down syndrome
Down syndrome is a human genetic condition characterized by the presence of an extra copy of autosomal chromosome 21, resulting in a total count of 47 chromosomes per cell. Known as trisomy 21, this non-disjunction defect causes distinct physical features, characteristic facial traits, and delayed cognitive development throughout life.

125. (A) Phenotype
Phenotype describes the observable physical, anatomical, physiological, and behavioral traits manifested by an organism. It results from the dynamic expression of its underlying inherited genotype interacting with external environmental influences such as temperature, nutrition, and sunlight throughout development, reflecting how genetic traits physically manifest within specific living conditions.

126. (B) Homozygous recessive
A recessive genetic trait is expressed in an organism's phenotype only when its genotype is homozygous recessive. Because dominant alleles mask recessive alleles in heterozygous conditions, expressing a recessive feature requires an individual to inherit two identical recessive alleles, ensuring the absence of any dominant allele at that locus.

127. (C) Brown
An individual possessing a heterozygous Bb genotype for eye color will have brown eyes. Because the B allele for brown eyes is dominant over the b allele for blue eyes, the presence of a single dominant B allele completely masks the recessive blue allele, dictating the brown ocular phenotype.

128. (D) Fossils
Fossils supply the most direct biological evidence for the historic existence of extinct species. Preserved within sedimentary rock formations across geological epochs, mineralized bones, imprints, and fossilized structural traces allow scientists to reconstruct extinct organisms, trace evolutionary adaptations, and document structural changes over millions of Earth's historical years.

129. (B) During meiosis
Crossing over occurs during the prophase I stage of meiosis. During this specialized cell division process, non-sister chromatids of homologous chromosome pairs align closely and exchange corresponding segments of genetic material. This reciprocal DNA exchange breaks linkage groups, generating novel allele combinations that enhance genetic diversity in gametes.

130. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A.
Genetic variation is fundamental to species evolution because it introduces distinct phenotypic differences within a population. Natural selection operates directly upon these varied traits, favoring individuals possessing

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68. (D) Genetic mutation and recombination
Intraspecific variation among individuals of the same species primarily arises from genetic mutation and meiotic recombination. Mutations generate novel allelic variations in DNA, while independent assortment and crossing over during sexual reproduction shuffle existing alleles. Together, these genetic mechanisms produce unique genomic combinations, providing the essential diversity upon which natural selection operates.

69. (B) DNA
Genetic engineering relies on manipulating deoxyribonucleic acid, the macromolecule containing genetic instructions in living cells. By cutting, splicing, or transferring specific DNA sequences between organisms using restriction enzymes and vectors, scientists can directly alter cellular genomes to produce recombinant proteins, engineer disease-resistant crops, and develop advanced targeted gene therapies.

70. (A) I and II
In human sex determination, females possess two X sex chromosomes in their somatic cells, whereas males carry one X and one Y sex chromosome. During fertilization, the mother contributes an X chromosome through her egg, while the father provides either an X or a Y chromosome, making paternal sperm the determinant of sex.

71. (D) Genetic engineering
Synthesizing human insulin using recombinant DNA technology is a landmark achievement in applied genetic engineering. Scientists insert the human gene coding for insulin into bacterial plasmids, transforming bacteria into bio-factories capable of mass-producing pure human insulin for medical treatment, illustrating direct laboratory manipulation of genetic material for medical benefits.

72. (A) Acquired traits
Acquired traits are physical, physiological, or behavioral characteristics developed by an organism during its lifetime due to environmental influences, physical training, or bodily injury. Because acquired traits do not alter the genomic sequence within germline reproductive cells, they are not passed down to offspring, distinguishing them from inherited genetic traits.

73. (B) The gene is X-linked recessive.
Colour blindness is significantly more prevalent in males because it is governed by an X-linked recessive allele. Males possess only one X chromosome; inheriting a single defective allele from their mother results in full phenotypic expression. Females possess two X chromosomes, requiring two copies of the mutated allele to express the disorder.

74. (D) Mutation
Mutation serves as the ultimate source of genetic variation required for biological evolution. By altering base pair sequences or chromosomal arrangements, mutations generate brand-new alleles within a population's gene pool. Natural selection acts upon these novel phenotypic variations, driving adaptation, diversification, and speciation over successive generations in changing environments.

75. (B) 75% dominant and 25% recessive phenotype
Crossing two heterozygous individuals carrying a dominant allele A and a recessive allele a yields offspring with genotypes AA, Aa, and aa in a 1:2:1 ratio. Because the dominant allele masks the recessive allele in heterozygous individuals, 75% of the offspring display the dominant phenotype while 25% exhibit the recessive phenotype.

76. (B) 23
A normal diploid human somatic cell contains 46 total chromosomes arranged into 23 distinct matching pairs. Among these, 22 pairs are non-sex autosomes responsible for general body traits, while one pair consists of sex chromosomes determining biological sex. This diploid number ensures proper genetic complement distribution during cellular mitoses.

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77. (C) Sequence of nitrogenous bases
The linear sequence of nitrogenous bases along a DNA molecule forms the precise molecular code of genetic information. Comprising adenine, thymine, cytosine, and guanine, these arranged base triplets code for specific amino acids during protein synthesis, directly dictating cellular structure, enzymatic functions, and inherited biological traits across organisms.

78. (D) Having dimples
Having dimples is an inherited genetic trait governed by hereditary DNA sequences passed down from parents to offspring. Conversely,

severe vitamin C deficiency rather than inherited genetic mutations.

141. (B) Mother
A male with red-green color blindness inherited the mutated gene exclusively from his mother. The gene for color blindness is located on the X chromosome. Because a male receives his single X chromosome from his mother and his Y chromosome from his father, his X-linked traits are inherited maternal characteristics.

142. (B) Genetic engineering
Developing Bt Cotton exemplifies applied genetic engineering in modern agriculture. Scientists isolate a gene from the bacterium Bacillus thuringiensis encoding an insecticidal protein and insert it directly into the cotton genome. The genetically modified plant synthesizes its own toxin, conferring built-in resistance against destructive bollworm agricultural pests.

143. (B) It studies two traits simultaneously.
A dihybrid cross involves studying the simultaneous inheritance patterns of two distinct, unlinked genetic traits across generations. By crossing individuals that differ in two observable characteristics, such as seed shape and seed color, geneticists evaluate how different allele pairs assort independently into gametes during meiotic cell division processes.

144. (D) Having genotype IA i
An individual possesses a heterozygous genotype for blood group A when carrying the genotype IA i. This combination features two different alleles at the ABO gene locus: a dominant IA allele coding for A antigens and a recessive i allele. The resulting individual phenotypically expresses blood group A while remaining heterozygous.

145. (A) It remains hidden.
In the F_1 generation of a Mendelian monohybrid cross, the recessive trait remains phenotypically hidden or masked. Offspring inherit one dominant allele and one recessive allele, resulting in a heterozygous genotype. Because the dominant allele determines the phenotype, the recessive characteristic is unexpressed until re-emerging in the F_2 generation.

146. (B) Analogous
Analogous structures are anatomical features in different species that perform identical functions but evolved independently through convergent evolution rather than from a common ancestor. Classic examples include bird wings and insect wings, which share functional similarities for flight despite possessing completely different structural layouts and underlying developmental origins.

147. (D) Sedimentary rock
Fossils are primarily found within sedimentary rocks, which form through gradual accumulation, compaction, and cementation of mineral and organic sediments over long periods. Unlike high-temperature igneous or metamorphic rocks that destroy biological tissue, gentle sedimentary deposition preserves bones, shells, imprints, and structural traces of ancient living organisms intact.

148. (C) Law of Independent Assortment
Mendel's Law of Independent Assortment states that alleles for distinct characteristics are inherited independently during gamete formation. This principle applies to unlinked genes located on different chromosomes, ensuring that the inheritance pattern of one trait does not influence or alter the independent inheritance probability of an unrelated physical trait.

149. (D) Mutation
A mutation is defined as an alteration in the nucleotide sequence of DNA that can alter gene expression and produce observable changes in phenotype. Occurring spontaneously or induced by radiation and mutagens, mutations introduce new alleles into a population, serving as the primary driver of genetic diversity and evolution.

150. (A) I and II
Down syndrome is a human chromosomal disorder caused by an extra copy of autosomal chromosome 21, known as trisomy 21. It leads to characteristic physical features, cognitive delays, and physiological development changes. Because chromosome 21 is an autosome, Down syndrome affects both sexes equally and is not sex-linked.

151. (A) A DNA segment coding for a specific protein
A gene is best defined as a specific segment of a DNA molecule that contains coded instructions required to synthesize a functional protein or RNA molecule. Serving as the basic functional unit of heredity, genes directly dictate cell structure, enzymatic activity, and the physical inheritance of biological traits across generations.

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adaptations that enhance survival and reproduction. Over generations, this differential success drives evolutionary change, making genetic variation the essential raw material for adaptation.

131. (D) Insect wing
An insect wing is not a homologous structure when compared with human arms, whale flippers, or bat wings. Human arms, whale flippers, and bat wings share a fundamental skeletal arrangement inherited from a common mammalian ancestor, whereas insect wings are non-homologous cuticular structures that evolved independently through convergent adaptation.

132. (B) 7
Gregor Mendel studied seven distinct pairs of contrasting traits in his inheritance experiments using garden pea plants. These traits included plant height, pod shape, pod color, seed shape, seed color, flower position, and flower color. Tracking these seven clear binary characteristics allowed Mendel to formulate basic quantitative inheritance laws.

133. (B) Locus
The specific, fixed physical position occupied by a gene or DNA sequence along a chromosome is called its locus. Homologous chromosomes carry matching gene loci, where corresponding maternal and paternal alleles reside. Mapping gene loci helps geneticists determine chromosomal structures, analyze gene linkages, and track inherited traits across generations.

134. (B) Genetic counselling
Genetic counseling directly addresses the probability and risk of passing inherited genetic disorders to future offspring. Professional counselors evaluate family medical histories, interpret diagnostic genetic tests, explain underlying inheritance patterns, and guide prospective parents through reproductive choices and medical management options in a supportive, informative clinical healthcare setting.

135. (B) They will undergo speciation into distinct species.
Prolonged geographical isolation between two populations of a single species halts gene flow between them. Exposed to distinct local selection pressures, independent genetic mutations, and random genetic drift, each population diverges genetically over time. Eventually, reproductive isolation develops, leading to speciation and the emergence of two separate species.

136. (C) To enhance crop yield and disease resistance
Generating improved seed varieties through genetic principles enhances crop yield, disease resistance, and nutritional value in modern agriculture. By selectively breeding plants with advantageous traits, farmers cultivate high-performing crop strains that withstand environmental stressors, resist viral or fungal pathogens, and produce larger agricultural harvests to support food security.

137. (D) Round seeds
In Mendelian genetics of pea plants, round seed shape is a dominant trait, while wrinkled seed shape is recessive. When purebred round-seeded plants are crossed with purebred wrinkled-seeded plants, all first-generation offspring produce round seeds because the dominant round allele completely masks the presence of the recessive wrinkled allele.

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138. (B) Charles Darwin
The concept that the environment selects organisms with advantageous traits for survival and reproduction is attributed to Charles Darwin. Through his theory of evolution by natural selection, Darwin demonstrated how natural environmental pressures act on existing heritable variations, allowing better-adapted individuals to pass their beneficial traits to future generations.

139. (B) Incomplete dominance
Incomplete dominance is a genetic pattern where neither allele for a trait is completely dominant over the other. In heterozygous individuals, the phenotype expressed is an intermediate blend of both parental traits, such as pink flowers produced by crossing red-flowered and white-flowered snapdragon plants, demonstrating non-Mendelian trait expression.

140. (A) P-2, Q-1, R-4, S-3
Haemophilia is an X-linked recessive disorder impairing blood clotting, while Down syndrome results from an extra copy of chromosome 21. Color blindness is governed by an X-linked recessive gene affecting color vision. Scurvy is a non-genetic nutritional disorder caused by

event does not completely wipe out the entire crop yield.

163. (B) A nucleotide
A nucleotide is the repeating structural monomeric subunit constructing DNA and RNA nucleic acid molecules. Each individual nucleotide is composed of three linked chemical groups: a five-carbon sugar molecule, a nitrogenous base, and a phosphate group. Covalent linkage of nucleotides forms the sugar-phosphate backbone carrying genetic information in cells.

164. (D) tt
The term homozygous describes a genetic condition where an organism carries two identical alleles for a specific gene. The allele pair tt represents a homozygous recessive genotype because both alleles are completely identical. In contrast, genotypes like Tt, AB, and Xy feature non-identical alleles, representing heterozygous or hemizygous chromosomal conditions.

165. (A) Homologous chromosomes
The Law of Segregation is fundamentally based on the separation of homologous chromosomes during the anaphase I stage of meiotic cell division. As homologous pairs segregate into different daughter cells, the allele pairs carried on them separate so that each resulting gamete receives only one allele per specific inherited gene trait.

166. (B) Mother
A male child inherits his single X chromosome exclusively from his mother. Human females carry two X chromosomes and pass one X chromosome to every egg cell. In contrast, the father contributes a Y chromosome to male offspring, which determines male sex development and pairs with the maternal X chromosome.

167. (B) Formation of a new species from an existing one
Speciation is defined as the evolutionary mechanism leading to the formation of one or more new species from a pre-existing ancestral population. Driven by factors like geographic isolation, genetic drift, natural selection, and mutation accumulation, speciation halts gene flow between populations until irreversible reproductive isolation is fully established.

168. (C) Appendix
The vermiform appendix is considered a vestigial organ in humans. Inherited from herbivorous evolutionary ancestors who required a larger cecum for digesting cellulose, the human appendix has lost its original primary digestive function. Its reduced size and non-essential role serve as anatomical evidence of ancestral human lineage structural modifications.

169. (D) Dihybrid cross
Mendel performed a dihybrid cross to deduce the Law of Independent Assortment. By simultaneously tracking two distinct contrasting characteristics, such as seed shape and seed color, across generations, Mendel observed that pairs of alleles for different traits segregate into gametes independently of one another during meiotic cell division.

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170. (C) Assertion (A) is true but Reason (R) is false.
The F_2 generation of a Mendelian monohybrid cross exhibits a 3:1 phenotypic ratio because heterozygous F_1 plants self-pollinate. However, the recessive trait is not permanently lost in F_1 plants; it remains hidden phenotypically behind the dominant allele and re-emerges unchanged in 25% of F_2 offspring in homozygous recessive form.

171. (A) It is older than fossils found in shallower layers.
Fossils buried deep within Earth's sedimentary rock layers are generally older than those found in shallower layers, according to the geological law of superposition. Newer sediment layers deposit sequentially on top of older layers over geological time, allowing paleontologists to determine relative fossil ages and trace evolutionary chronological history.

172. (B) Genes
Genetic engineering fundamentally involves the deliberate, artificial manipulation of an organism's genes using modern laboratory biotechnology techniques. By modifying, deleting, or inserting specific DNA sequences across species, scientists create genetically modified organisms capable of producing valuable pharmaceutical proteins like insulin, exhibiting pest resistance, or expressing desired physiological traits.

173. (D) Blood group AB
An individual possessing the genotype IA IB phenotypically expresses blood group AB due to codominance between alleles. Both the IA and IB alleles express their respective A and B surface antigens simultaneously on red blood cells without blending or masking each other, demonstrating a distinct non-Mendelian pattern of inheritance.

174. (A) Sexual reproduction
Sexual reproduction allows the combination of genetic material from two distinct parents. Meiotic division produces haploid gametes containing recombined alleles. Fertilization fuses male and female gametes, combining maternal and paternal DNA to create a genetically unique diploid zygote, thereby generating offspring variation essential for natural selection and evolution.

175. (A) III, I, II, IV
Natural selection follows a clear logical sequence. First, inherited genetic variation exists within a natural population. Second, organisms overproduce offspring beyond environmental carrying capacities, creating competition for limited resources. Third, survival of the fittest occurs as best-adapted individuals survive. Finally, favorable traits are transmitted successfully to the next generation.

176. (B) Colour blindness
Color blindness is a primary focus of genetic counseling because it is an X-linked recessive hereditary disorder passed down through family lineages. In contrast, conditions like typhoid, cholera, and malaria result from infectious bacterial or parasitic pathogens and environmental exposure rather than inherited genetic abnormalities present within DNA.

177. (B) Charles Darwin
The evolutionary phrase survival of the fittest was coined by philosopher Herbert Spencer and later adopted by Charles Darwin to illustrate natural selection. In Darwinian theory, fitness describes an organism's reproductive success and adaptation to its environment, where individuals with advantageous traits survive and pass those traits to offspring.

178. (C) 9:3:3:1
The phenotypic ratio in the F_2 generation of a standard Mendelian dihybrid cross is 9:3:3:1. This mathematical outcome reflects four distinct phenotypic combinations: nine showing both dominant traits, three showing the first dominant and second recessive, three showing the first recessive and second dominant, and one showing both recessive traits.

179. (C) Mutation
A permanent alteration in the nucleotide sequence of cellular DNA is called a mutation. Arising spontaneously from replication errors or induced by environmental radiation and mutagens, mutations alter base sequences or chromosomal structures. They generate brand-new alleles, serving as the ultimate source of genetic diversity required for biological evolution.

180. (A) P-3, Q-4, R-2, S-1
Eye color is an inherited trait determined by genetic inheritance, while muscular build from weightlifting is an acquired trait. Haemophilia represents a genetic disorder caused by X-linked recessive mutations affecting blood clotting. X and Y represent sex chromosomes that dictate biological sex in humans, establishing the correct matching pairings.

181. (B) The father, by contributing either an X or a Y chromosome
In human sex determination, the father dictates the offspring's biological sex. Human females carry two X chromosomes and produce eggs carrying only X chromosomes. Human males possess one X and one Y chromosome, producing sperm cells with either X or Y chromosomes. Fertilization by X-bearing or Y-bearing sperm yields female or male offspring.

182. (B) They ensure traits are homozygous and breed true when self-pollinated.
Purebred pea plants were necessary for Mendel's initial parental generation because they are homozygous for the studied traits, ensuring they breed true when self-pollinated. Utilizing homozygous parent lines established a consistent genetic baseline, allowing Mendel to accurately track dominant and recessive allele inheritance patterns in subsequent cross-pollinated offspring generations.

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183. (D) Genome
The complete set of genes and genetic material contained within an organism's haploid set of chromosomes is known as its genome. The genome encompasses all nuclear DNA sequences, including coding genes and non-coding sequences, providing the complete biological blueprint governing cellular functions, development, physiological activities, and hereditary traits.

184. (B) Selective breeding
Applying genetic principles to improve cattle breeds for higher milk production is an example of selective breeding, or artificial selection. Livestock breeders intentionally select and mate individual cows and bulls displaying desirable traits, such as superior milk yield, ensuring that advantageous alleles are consistently transmitted to future livestock generations.

185. (A) 25%
When two carrier parents who are heterozygous for an autosomal recessive disorder mate, each parent contributes a recessive allele with a 50% probability. Combining these probabilities gives a 25% chance (1 in 4) that a child will inherit two recessive alleles, expressing the inherited genetic disorder phenotypically at birth.

186. (C) Similar function in all species
Homologous organs are anatomical structures in different species that share a similar structural layout and early embryonic developmental origin, providing clear evidence of shared evolutionary ancestry. However, homologous organs do not share identical functions in all species, as they adapt through divergent evolution to serve distinct tasks like flying, swimming, or running.

187. (D) Genetic diversity
The presence of a wide variety of different alleles within a population is termed genetic diversity. High genetic diversity equips a population with varied phenotypic traits, increasing the likelihood that certain individuals possess adaptations to survive environmental changes, disease outbreaks, or climate shifts, thereby reducing the risk of species extinction.

188. (C) 47, +21
The genetic status 47, +21 represents the exact chromosomal genotype for Down syndrome. This notation indicates a total count of 47 chromosomes instead of the normal 46, caused by an extra third copy of autosomal chromosome 21. This trisomy 21 condition leads to characteristic physical and cognitive developmental variations.

189. (B) Dominant
A genetic trait that masks or hides the physical expression of another trait in a heterozygous individual is called dominant. The dominant allele dictates the observable phenotypic characteristic of the organism, while the masked allele remains recessive and is expressed only when present in a homozygous recessive genotype.

190. (A) I and II
Speciation occurs when populations become reproductively isolated, preventing gene flow between them. Over time, independent genetic mutations, genetic drift, and natural selection cause genetic differences to accumulate, leading to distinct species. Statement III is incorrect because speciation results in groups that can no longer interbreed successfully with each other.

191. (C) Nitrogenous base pairs
Nitrogenous base pairs form the horizontal rungs or steps of the double-stranded DNA ladder model. Adenine pairs specifically with thymine via two hydrogen bonds, while guanine pairs with cytosine via three hydrogen bonds. These paired bases connect the outer sugar-phosphate backbones, maintaining the double-helix structure and encoding genetic information.

192. (A) Monohybrid cross
A monohybrid cross is a genetic cross designed to study the inheritance pattern of a single trait governed by one gene locus. By crossing parents differing in one pair of contrasting characteristics, such as plant height, geneticists analyze how single allele pairs segregate and express dominant or recessive phenotypes in offspring.

193. (B) Homologous organs - Morphological evidence
Homologous organs are correctly paired with morphological evidence of evolution. Studying anatomical similarities, such as matching forelimb bone structures in humans, bats, and whales, provides physical morphological proof that these diverse species evolved from a common tetrapod ancestor, modifying shared anatomical layouts over time to adapt to different environments.

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194. (B) Fossils show structural transitions between extinct and modern species.
Studying fossils is vital for understanding evolution because fossils reveal transitional anatomical features connecting extinct ancestors with modern living species. Preserved in sedimentary rock layers across geological epochs, fossilized remains allow paleontologists to reconstruct evolutionary chronologies, track morphological modifications over time, and document how biodiversity developed across history.

195. (B) II, III, and IV
Genetic mutations are sudden permanent alterations in DNA base sequences that can create new allelic variants. While some mutations are neutral or harmful, beneficial mutations provide advantageous traits that natural selection operates upon, driving evolutionary adaptation. Thus, stating that mutations are always harmful is incorrect, making statements II, III, and IV valid.

196. (B) Male
The sex chromosome combination XY dictates male biological sex in human beings. In human sex determination, females carry two X sex chromosomes (XX), while males possess one X and one Y chromosome (XY). The inheritance of a Y chromosome from paternal sperm initiates male gonadal differentiation and embryonic development.

197. (D) The interaction between its genotype and the environment
An organism's observable phenotypic traits are produced by the dynamic interaction between its inherited genetic makeup, known as its genotype, and surrounding environmental conditions. While genotype provides the foundational genetic blueprint, environmental factors such as diet, temperature, light, and stress influence how these genes are expressed during development.

198. (C) Mass production of insulin using modified bacteria
Mass-producing human insulin using genetically modified bacteria represents a prime example of applied genetic engineering in modern medicine. Scientists insert the human gene for insulin into bacterial plasmids, transforming E. coli into biological factories that synthesize pure human insulin, revolutionizing diabetes treatment compared to traditional animal-derived insulin extraction methods.

199. (B) Chromosomal separation during meiosis
Mendel's Law of Segregation is directly linked to the cellular mechanism of chromosomal separation during meiosis. Specifically, during anaphase I and II of meiotic cell division, homologous chromosome pairs and sister chromatids segregate into separate daughter cells, ensuring each mature gamete receives only one allele for every gene locus.

200. (A) Inherited traits are recorded in DNA, while acquired traits are not.
The primary distinction between inherited and acquired traits lies in their molecular genetic basis. Inherited traits are encoded in the nucleotide sequences of nuclear DNA within germline cells and transmitted to offspring. In contrast, acquired traits develop during an organism's lifetime from environmental influences or physical practice, leaving germline DNA sequences completely unaltered.

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